Assessment of Dam Safety
Coal Combustion Surface Impoundments (Task 3)
Draft Report

Northern States Power Company

Sherburne County Power Station

Becker, Minnesota

Prepared for

Lockheed Martin

2890 Woodridge Ave #209
Edison, New Jersey 08837

October 18, 2009

CHA Project No. 20085.2010.1510

CHA

I acknowledge that the management units referenced herein:

- Bottom Ash Pond
- Pond No. 1
- Pond No. 2
- Pond No. 3

Has been assessed on September 16, 2009.

Signature: _____

Malcolm D. Hargraves, P.E.
Senior Geotechnical Engineer

Signature: _____

Anthony P. Stellato, P.E.
Vice President
Registered in the State of Minnesota

Reviewer: _____

Warren A. Harris, P.E.
Geotechnical Operations Manager

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APPENDIX

1.0 INTRODUCTION & PROJECT DESCRIPTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United State Environmental Protection Agency) to perform site assessments of selected coal combustion surface impoundments (Project #0-381 Coal Combustion Surface Impoundments/Dam Safety Inspections). As part of this contract, CHA was assigned to perform a site assessment of Northern States Power Company's (NSPC, a subsidiary of Xcel Energy, Inc.) Sherburne County Power Station, located in Becker, Minnesota as shown on Figure 1 – Project Location Map.

CHA made a site visit on September 16, 2009 to inventory coal combustion surface impoundments at the facility, to perform visual observations of the impoundment dikes, and to collect relevant information regarding the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3 impoundments.

CHA engineers Malcolm Hargraves, P.E. and Anthony Stellato, P.E. were accompanied by the following individuals:

Company or Organization Name	**Name**
McCain and Associates, Inc.	John R. McCain, P.E., Principal Engineer
Minnesota DNR, Dam Safety Section	Jason Boyle, State Dam Safety Engineer
US Environmental Protection Agency Region 5	Nate Nemani, RCRA Corr. Action Manager
Xcel Energy, Inc.	Steve Bluhm, Sr. Plant Engineer
Xcel Energy, Inc.	Daniel J. Orr, Sr. Environmental Analyst
Xcel Energy, Inc.	Mary Deiltz, Manager, Environmental Services
Xcel Energy, Inc.	Roger Clarke
Xcel Energy, Inc.	Scott Thomas, Engineer
Xcel Energy, Inc.	Chuck Donkers, Geologist

1.2 Project Background

The Bottom Ash Pond, Pond No. 2 and Pond No. 3 at the Sherburne County Power Station are regulated by the Minnesota Department of Natural Resources, Dam Safety Section. These impoundments are listed on the National Inventory of Dams (NID) collectively as NID ID No. MN00980 and are referenced by the Minnesota Department of Natural Resources (MNDNR) as File No. MN01535. These impoundments are classified by the state as Class II structures (Significant Hazard). Minnesota's dam safety law defines a Class II hazard classification as one having possible health hazard or probable loss of high-value property, damage to secondary highways, railroads or other public utilities, or limited direct or indirect economic loss to the public as a result of a failure.

These impoundments have been given a "significant" hazard rating, as shown on the EPA Coal Combustion Dam Inspection Checklists and Coal Combustion Waste (CCW) Impoundment Inspection Forms included Appendix A, based on the potential for environmental damage in the event of a catastrophic failure of the impoundment dikes.

Pond No. 1 at the facility is permanently closed and is currently being dewatered. MNDNR still lists the pond as an active dam. A NSPC site engineer has estimated the Pond No. 1 impoundment as having a classification of "Low Hazard".

This impoundment has been given a "low" hazard rating, as shown on the EPA Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Form included Appendix A.

1.2.1 State Issued Permits

NSPC has received the following state issued permits for the impoundments at the Sherburne County Power Station:

- The State of Minnesota has issued to Xcel Energy National Pollutant Discharge Elimination System (NPDES)/ State Disposal System (SDS) Permit No. MN0002186 authorizing discharge under the National Pollutant Discharge Elimination System (NPDES) to the Mississippi River in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective on August 21, 2009 and will expire on July 31, 2014. Numerous applications for modifications to the permit have been submitted to MNDNR and approved for modifications to the ponds. As noted in Sections 1.3.1 through 1.3.4 modifications have included vertical expansions and final closure and capping plans.
- Minnesota Department of Natural Resources – Division of Water Permit No 83-3152 to construct the ponds.

1.3 Site Description and Location

The Sherburne County Power Station is located approximately 2 miles north of Interstate 95 in Becker, Minnesota. Figure 2 – Photo Site Plan shows the locations of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3. The Mississippi River is located approximately 0.3 miles to the southwest of the ponds. An aerial photograph of the region indicating the location of the Sherburne County Power Plant and identifying schools, hospitals, or other critical infrastructure located within approximately five miles down gradient of the primary and secondary ash ponds is provided as Figure 7 – Critical Infrastructure Map.

Bottom ash generated at each of the three generating units at the Sherburne County Power Plant is hydraulically transported to the Bottom Ash Pond which temporarily stores the ash until it can be removed from the pond. The Bottom Ash Pond is described in greater detail in Section 1.3.1.

Fly ash and scrubber solids from Generating Units 1 and 2 are hydraulically transported to Pond No. 2 and Pond No. 3. The ponds allow for the settlement of solids and will provide permanent disposal after dewatering and capping. Pond No. 2 is in the final stage of filling and

approximately 40% of the pond is closed with a geomembrane cover. Pond No. 3 is active and being constructed in stages as needed (Pond 3N and Pond 3S). Once the final covers are in place on Ponds No. 2 and 3 the ponds will be actively dewatered using pumps. Pond No. 1 is closed and with a geomembrane in place. The residual water retained in the pond is actively being removed using pumps and is approximately 67% dewatered. Pond No.1, Pond No.2 and Pond No. 3 are described in greater detail in Sections 1.3.2, 1.3.3 and 1.3.4, respectively.

The ash and scrubber solids from Generating Unit 3 at the facility are managed dry and are disposed of in a landfill located on the facility property. The landfill is lined with leachate collection, and is capped in stages with geomembrane as portions of the landfill are filled to capacity.

1.3.1 Bottom Ash Pond

The Bottom Ash Pond has a surface area of 18 acres and the minimum height of the embankment above surrounding grade elevation of 959 feet is 41 feet. The Bottom Ash Pond and Pond No. 1 were constructed at the same time and were designed by Black & Veatch Consulting Engineers. The Bottom Ash Pond was put into service in 1975 with the embankment crest at Elevation 1,000 feet, except for a portion at the northeast corner of the pond where the elevation was set at 975 feet to accommodate the bottom ash slurry piping.

Figure 2B shows the locations of the North, West and East Dams and the Center Dike which impound the Bottom Ash Pond and Figures 3A through 3D show typical cross sections of these dams. The dams were constructed with a clay core consisting of borrow soils classified as CL (Unified Soil Classification). The pond was lined with an impervious earth blanket. The material making up the blanket is reference to in the original construction drawings and specifications as Type 1 material consisting of borrow soils classified as CL soils. According to the project specifications the embankment fill soils were to consist of soils classified as SM, SP and SW soils.

In 1982, the northeast corner of the pond was raised 25 feet to match the crest at Elevation 1,000 feet. Onsite soils were used for the embankment construction. A 10-foot thick central clay core was constructed.

Water that is drained from the Bottom Ash Pond is routed to the Recycle Pond.

1.3.2 Pond No. 1

Pond No. 1 has a surface area of 62 acres and was put into service in 1975 with a crest elevation of 1,000 feet. Figure 2C shows the locations of the West, South and East, Dams and the Center Dike which impound Pond No. 1. Figures 4A through 4C and Figure 3C show typical cross sections for each of the dams as originally constructed. The minimum height of the embankment above the surrounding grade minimum elevation of 959 feet is 41 feet.

Water and ash are no longer sluiced into Pond No. 1. The pond was capped with 40-mil HDPE geomembrane beginning in 1990. The pond remained in service until final closure was completed in 1995. The volume of scrubber solids deposited in the pond is about four million cubic yards. There is another approximate one million cubic yards of ash placed above the impoundment crest to shape the final cover grade and allow the cap to shed runoff. Figure 9 shows the sequence in which the pond was capped and closed.

To reduce hydraulic head and minimize infiltration through the clay liner and into the sand and gravel groundwater aquifer below the pond dewatering wells have been installed and are actively removing water from the pond. During our site visit NSPC stated that the current average water elevation in the pond is at elevation 962 feet.

1.3.3 Pond No. 2

Pond No. 2 has a surface area of 100 acres. The pond was constructed during the summers of 1983 and 1984 by Ames Construction, Inc. of Burnsville, MN and put into service in 1984 with a crest elevation of 992.5 feet. Pond No. 2 was designed by Black & Veatch Consulting Engineers and soil testing during construction was performed by Braun Engineering, Inc.

The pond bottom and dams are lined with a continuous layer of clay. The bottom is lined with a minimum of 18 inches of clay. The West Dam contains a vertical clay core, 20 feet wide at the bottom, and narrowing to 10 feet at the top. The other dams have a slope liner made of a minimum of 24 inches of clay. Where the North and South Dams connect to the West Dam the clay liner thickness increases from 24 inches to 36 inches. These areas also have an area where the transition was made from clay core to clay slope liner. The area around the discharge structure within the North Dam is sealed with a combination of clay liner and clay core. In addition, there is a PVC liner under the discharge structure to collect any seepage past the clay liner. Figure 2D shows the locations of the North, West, South and East Dams which impound Pond 2. Figure 5A shows a typical cross section of the North, East and South Dams and Figure 4C show typical cross sections for the West Dam.

Pond No. 2 has been expanded three times to a final crest elevation of 1,012 feet. An application for an amendment to NPDES Permit No. 0002186 was submitted by Barr Engineering Company in January 1995 on behalf of the facility. The permit amendment was sought for vertical development of Pond No. 2, which involved the placement of liner and cover materials above the existing ash to cap and close the pond. Figures 5B and 5C show typical cross sections for the dams raised to elevation 1,012 feet. Figure 5D shows anticipated site cross sections for Pond No. 2 following capping and final closure. The minimum height of the embankment is 57 feet above the surrounding minimum grade elevation of 955 feet.

At present the pond is substantially filled and is in the process of being closed. There is approximately 9 million cubic yards of scrubber solids and ash in the pond. Approximately 40% of the pond has been permanently closed and capped with a geomembrane liner. Approximately 1.2 million cubic yards of ash has been placed above the impoundment crest to shape the final cover grade and to allow the cap to shed runoff. Dewatering wells have been installed in the portions of the pond which have been capped and will be activated once final closure is complete.

1.3.4 Pond No. 3

Pond No. 3 is divided into two sections; Pond No. 3S (South) and Pond 3N (North). Pond 3N was put into service in 2004 with a crest elevation of 976 feet. Pond 3N was expanded in 2008 to a crest elevation of 997 feet. The first phase of Pond No. 3S is planned for construction during the summer of 2010. The Pond No. 3N embankments will be raised to elevation 1,012 feet after Pond No. 3S is constructed.

Pond No. 3N has a surface area of 50 acres. The pond is lined with a composite liner consisting of a geosynthetic clay liner (GCL) overlain by 60 mil HDPE geomembrane, except for the upper portion of the West Side Slope has the existing Pond No. 2 clay liner below. The composite liner extends to elevation 960 feet on the north, east and south sides and to elevation 994 feet on the west side. On the north, east, and south sides waste containment above elevation 960 feet is provided by a clay barrier which slopes inward over the composite liner to elevation 1,010 feet. The existing Pond No. 2 clay liner extends to elevation 1,010 feet on the west side.

At present there is approximately 1.5 million cubic yards of ash and scrubber solids in the pond. The minimum height of the embankment is currently 57 feet above surrounding grade elevation of 940 feet. At completion of the Pond No. 3 the maximum height of the embankment will be 72 feet. Figure 2E shows the locations of the North, East, South Embankments and the West Side

Slope which impound Pond 2. Figure 6A through 6C shows a typical cross section of the North, East and South Embankments and the West Side Slope.

Clarified water from Pond 3N is recycled through plant for ash sluicing and FGD scrubber sluicing.

1.3.5 Other Impoundments

There are two incised basins at the facility that receive ash contact water. The Recycle Basin, constructed in 1975, is a combined process water and stormwater pond that is clay and HDPE composite lined with roller compacted concrete placed over the liner so that the pond can be dredged as needed. This basin receives the discharges from the Bottom Ash Pond which can contain small amounts of ash particle carryover from the pond to the basin.

The second incised basin is the Unit No. 3 Dry Ash Landfill Basin and was constructed in 1986. The basin is associated with the Generating Unit No. 3 dry ash landfill. The landfill has been designed to gravity drain leachate collected to a geomembrane lined basin. Water collected in the basin is recycled back to the plant process water system. Leachate is filtered through a granular drain located on the base of the landfill prior to entering the basin minimizing ash particles to the basin.

1.4 Previously Identified Safety Issues

Northern States Power Company reports that they have no record of spills or unpermitted releases from the ponds to surface water during the past ten years. There are records of two minor releases from the ponds to land.

In the spring of 2008, the piping used to transmit the fine fraction of the bottom ash from hydraulic dredging of the bottom ash pond broke and approximately 8000 gallons of water and

ash was discharged over the Bottom Ash Pond embankment to the ground. The integrity of the pond was not jeopardized by this event.

In May 2007, during closure of Pond No. 2 stormwater collected during a heavy rain event overtopped a temporary construction berm resulting in 600 gallons of rainwater, ash and soil flowing down the side of Pond No. 2 embankment to the ground. The integrity of the pond was not jeopardized by this event.

1.5 Site Geology

Based on a review of available surficial and bedrock geology maps, and reports by others, the soil at the site of the Sherburne County Power Station consists of glacial till and outwash material.

The bedrock beneath the site consists of Precambrian granite. The bedrock surface is reportedly irregular in nature. Two distinct valleys have been found within the confines of the facility property. The predominant valley runs east to west and crosses the Pond No. 3 location.

1.6 Bibliography

CHA reviewed the following documents provided by Northern States Power Company in preparing this report.

- Northern States Power Company Response Request for Information Relating to Surface Impoundments Under 104 (e)of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9604(e), Letter dated March 26, 2009 to US Environmental Protection Agency;
- Application for Disposal System Permit, July 2, 1971;

- *Specifications and Documents Coal and Ash Storage Area Construction*, May 22, 1973, Black & Veatch Consulting Engineers;
- *Review of Design Criteria and Project Specifications Proposed Coal Ash Storage Area*, July 17, 1973, Dames & Moore;
- *Additional Strength Tests for Dike Core and Impervious Earth Blanket Clay*, July 27, 1974, Twin City Testing and Engineering Laboratory, Inc.;
- Reports No. 1 through No. 24 titled *Inspection and Testing During Earthwork Operations Coal and Ash Storage Areas*; July 1975 to November 1975;
- *Report of Observations and Test Program Bottom Ash Pond Revision*, December 22, 1982, Twin City Testing and Engineering Laboratory, Inc.;
- *Bottom Ash Pond Revision Independent Design Review*, June 7, 1982, Black & Veatch Consulting Engineers;
- *Scrubber Solids Pond Expansion Special Report*, August 11, 1981, Black & Veatch Consulting Engineers;
- *Earth Retaining Structures for Coal, Water and Ash Storage Supporting Analysis II-M*, June 27, 1973, Black & Veatch Consulting Engineers;
- *Specifications and Documents for Bottom Ash Modification*; April 6, 1982, Black & Veatch Consulting Engineers;
- *Report of Geotechnical Exploration and Design Preliminary Design of Vertical Expansion Landfill*, February 13, 1989, Twin City Testing and Engineering Laboratory, Inc.;
- *Report of Field Exploration and Testing Field Permeability and Groundwater Monitoring*, April 20, 1989, Twin City Testing and Engineering Laboratory, Inc.;
- *SHERCO No. 1 Landfill Phase II Work Plan*, Chuck Donkers, NSP, February 25, 1992;
- *Dam Operation and Maintenance Plan*, August 1985;
- *Replacement Fly Ash Pond Construction Summary*, LA Winter, P.E., Superintendent, Northern States Power, June 21, 1985;
- *Clay Liner Review*, February 20, 1985, Black & Veatch Consulting Engineers;

- *Scrubber Solids Pond/Scrubber Makeup System Description*, Black & Veatch Consulting Engineers;
- *Scrubber Solids Pond No. 2 Application for Amendment to NPDES Permit No. 002186* and Appendices, January 1995, Barr Engineering Company;
- *Construction Documentation Report Pond No. 3 Vertical Development Phase I* and associated drawings, NSPC, December 1995;
- *Construction Documentation Report Pond No. 3 Vertical Development Phase I* and associated drawings, NSPC, January 1997;
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- *Construction Observation Report Phase 3 Vertical Expansion Pond No. 2* and associated drawings, Polaris Group, December 11, 2000;
- *Application for Permit Modification Interior Diking Plan Scrubber Solids Pond No. 2*, Polaris Group, March 1, 2001;
- *Design File Information – Stability Analysis*, September 14, 2009, McCain and Associates, Inc.;
- *No. 3 Scrubber Solids Pond Hydrogeologic Evaluation Phase I – Preliminary Investigation and Phase II Work Plan*, NSPC, September 1994;
- *Construction Quality Assurance Plan Scrubber Solids Pond No. 3*, June 2002, McCain and Associates, Inc.;
- *Engineering Report Scrubber Solids Pond No. 3*, June 2002, McCain and Associates, Inc.;
- Permit Application Drawings Scrubber Solids Pond No. 3, June 2002, McCain and Associates, Inc.;
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- *Technical Specifications Scrubber Solids Pond No. 3*, June 2002, McCain and Associates, Inc.;

- *Scrubber Solids Pond No. 3 Hydrogeologic Evaluation Phase II – Field Investigation,* May 2002, Xcel Energy, Inc.;
- *Construction Documentation and Pre-Fill Certification Report Scrubber Solids Pond No. 3* and appendices, November 2004, Xcel Energy, Inc.;
- *Minor Permit Modification Revised Pond Development Phasing Scrubber Solids Pond No. 3,* July 2008; McCain and Associates, Inc.;
- *Construction Certification Report Pond No. 3 North Vertical Expansion,* February 2009; McCain and Associates, Inc.;
- Various Drawings (229 Total) as supplied by Northern States Power Station.

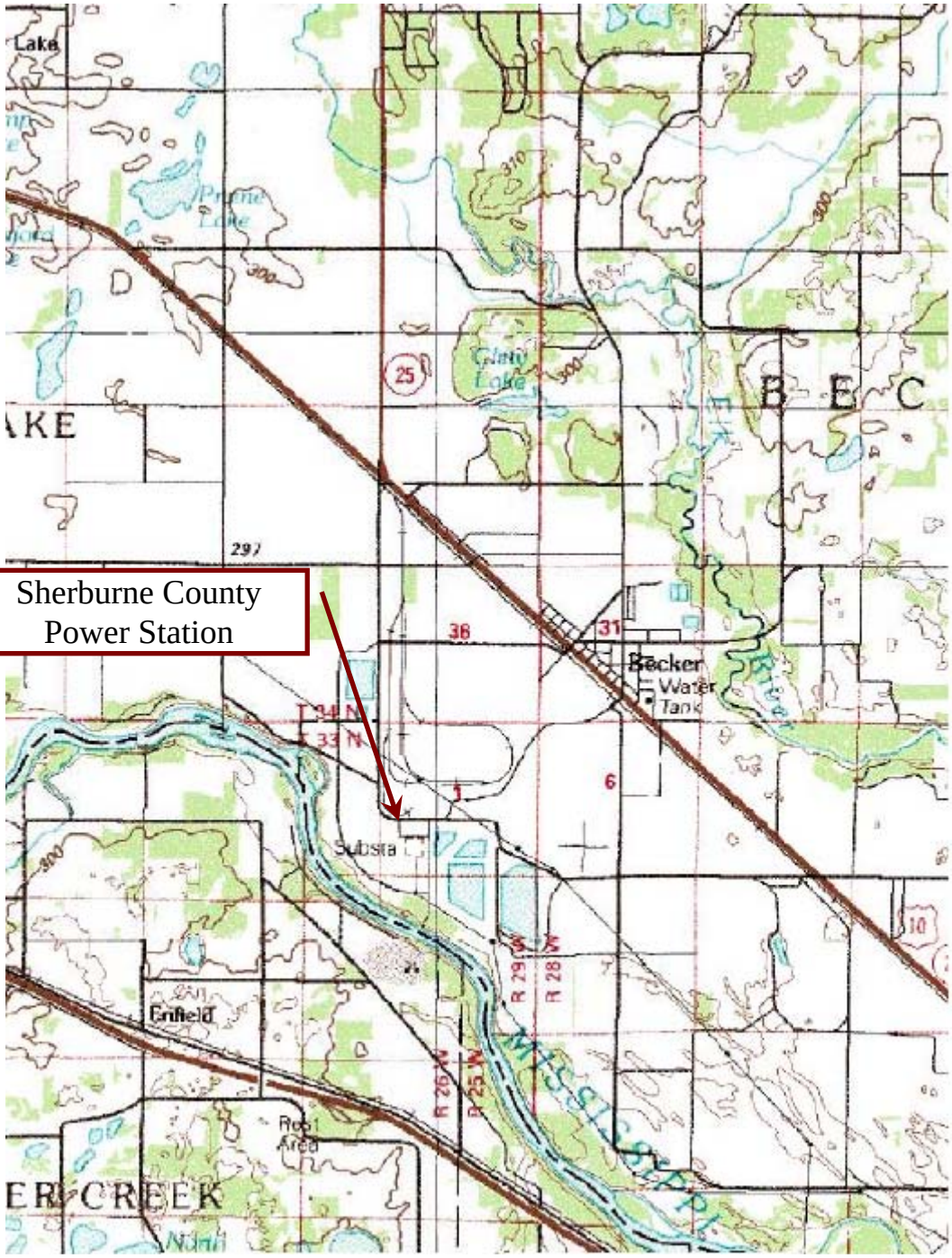

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Figure 1
Project Location Map

Scale: 1" = 1 mile	Project No.: 20085.2010.1510	Northern States Power Station Sherburne County Power Station Becker, Minnesota

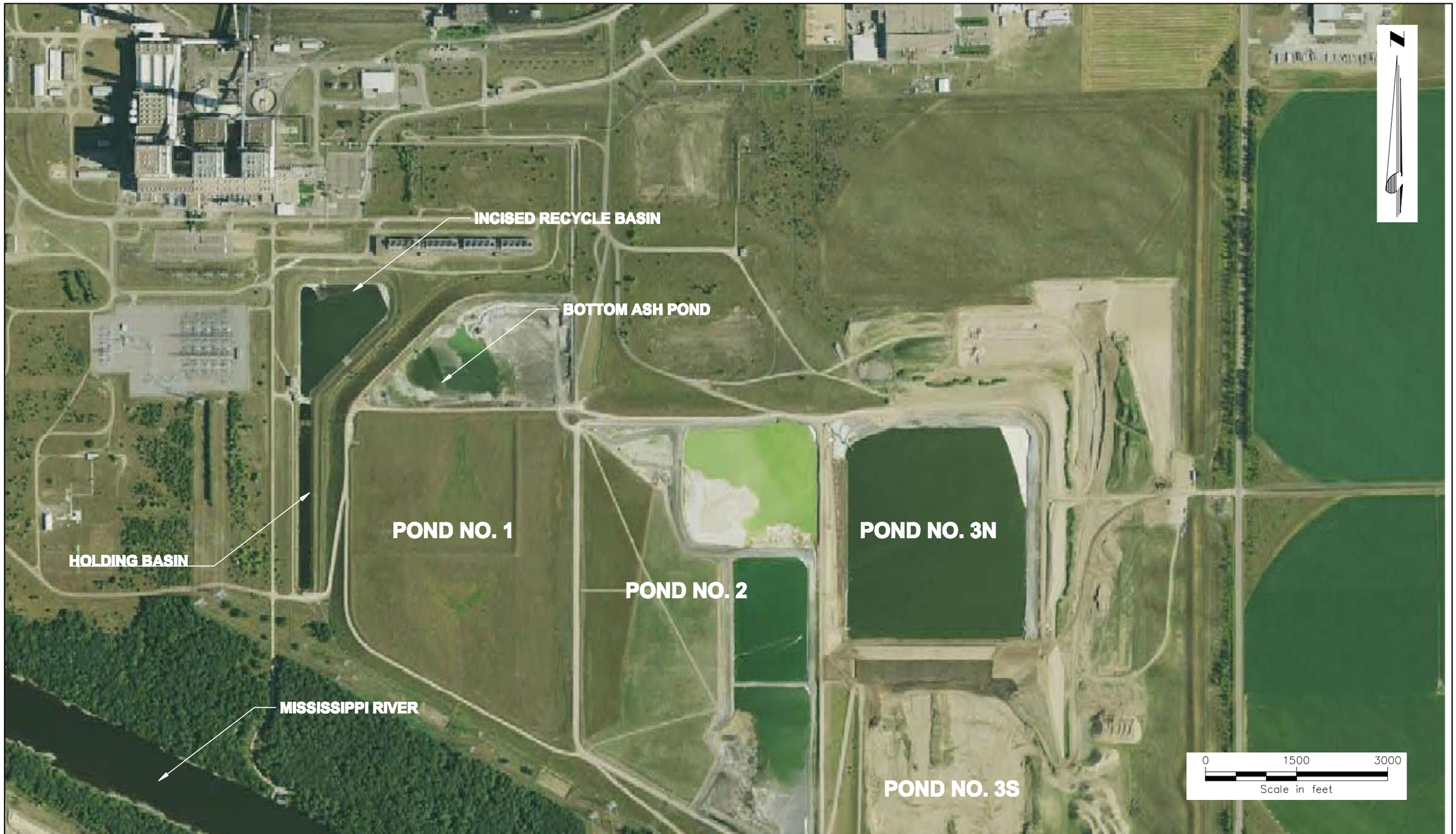

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

CHA
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PHOTO SITE PLAN

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 2A

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_2_PHOTO SITE PLAN.DWG Saved: 10/15/2009 3:17:37 PM PLotted: 10/16/2009 3:35:58 PM User: Jensen, Andrew

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

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PHOTO SITE PLAN BOTTOM ASH POND

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 2B

File: K:\20085\CADD\ACAD__SHEET_FILES\2010_2_PHOTO SITE PLAN.DWG Saved: 10/15/2009 3:17:37 PM Plotted: 10/16/2009 3:37:18 PM User: Jensen, Andrew

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

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PHOTO SITE PLAN POND NO. 1

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 2C

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_2_PHOTO SITE PLAN.DWG Saved: 10/15/2009 3:17:37 PM PLotted: 10/16/2009 3:38:21 PM User: Jensen, Andrew

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

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PHOTO SITE PLAN POND NO. 2

SHERBURNE COUNTY POWER STATION
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PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 2D

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

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Albany, NY

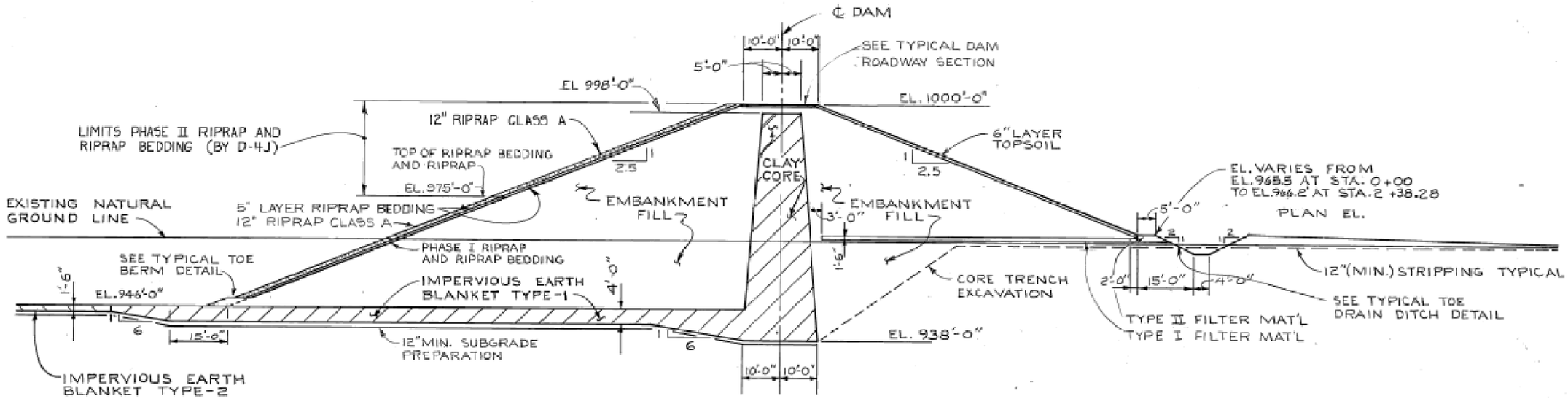
PHOTO SITE PLAN POND NO. 3

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 2E



TYPICAL NORTH DAM SECTION I

STA. 0+00 TO STA. 2 +38.28

SCALE: 1"=20'

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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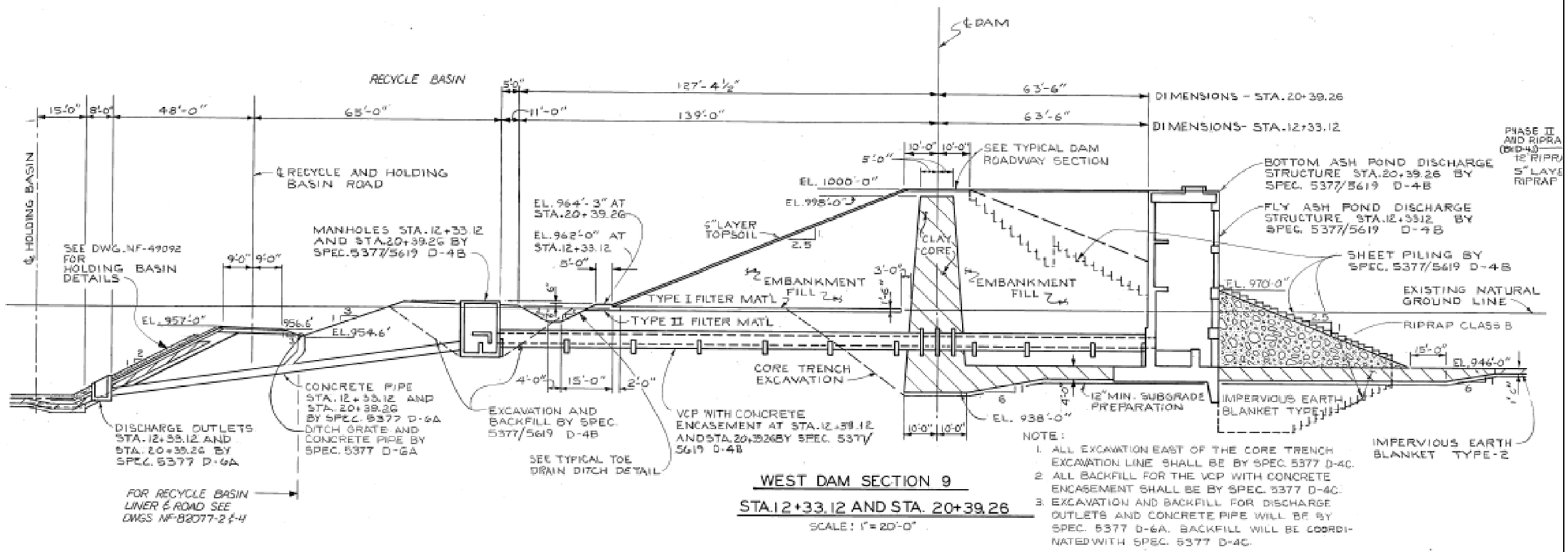
BOTTOM ASH POND TYPICAL CROSS SECTION NORTH DAM

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 3A



WEST DAM SECTION 9

STA. 12+33.12 AND STA. 20+39.26

SCALE: 1"=20'-0"

NOTE:
1. ALL EXCAVATION EAST OF THE CORE TRENCH EXCAVATION LINE SHALL BE BY SPEC. 5377 D-4C.
2. ALL BACKFILL FOR THE VCP WITH CONCRETE ENCASEMENT SHALL BE BY SPEC. 5377 D-4C.
3. EXCAVATION AND BACKFILL FOR DISCHARGE OUTLETS AND CONCRETE PIPE WILL BE BY SPEC. 5377 D-6A. BACKFILL WILL BE COORDINATED WITH SPEC. 5377 D-4C.

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

CHA
Albany, NY

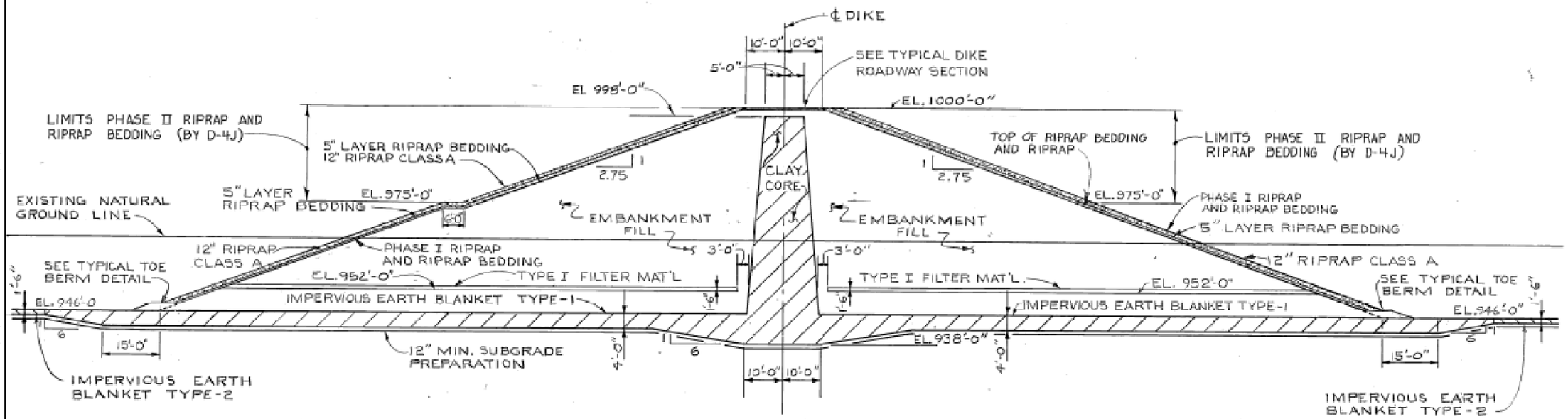
BOTTOM ASH POND TYPICAL CROSS SECTION WEST DAM

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 3B



TYPICAL CENTER DIKE SECTION - 3

STA. 0+00 TO STA. 14+80.00

SCALE: 1"=20'

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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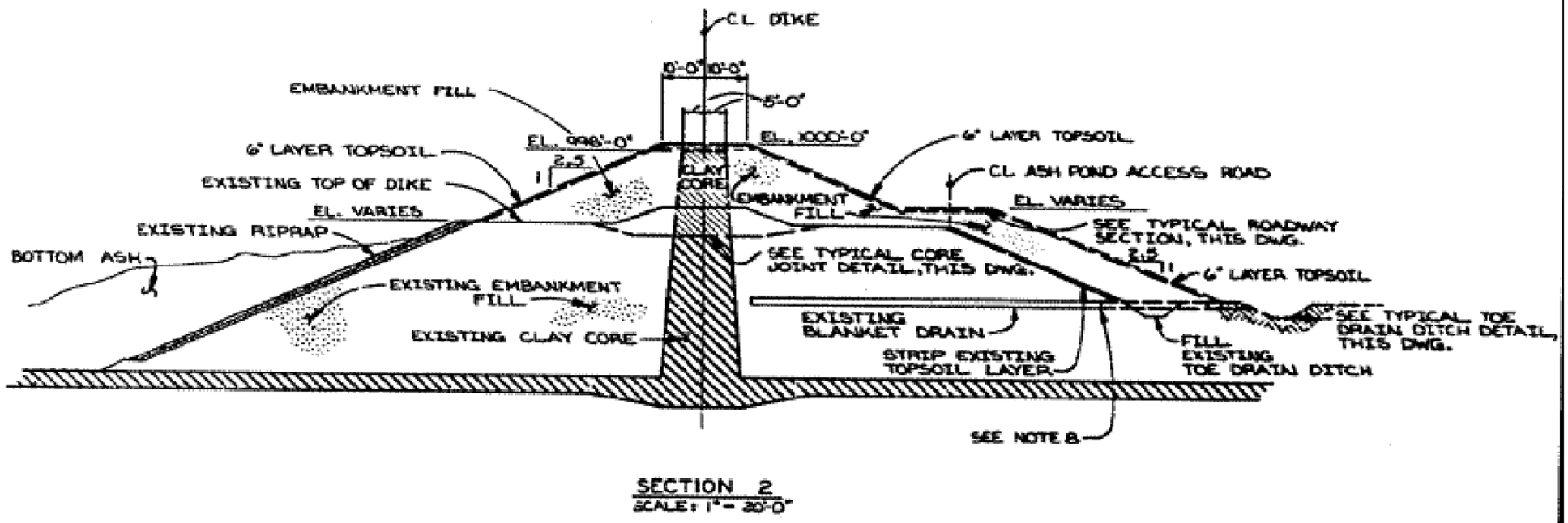
BOTTOM ASH POND TYPICAL CROSS SECTION CENTER DIKE
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 3C



SECTION 2
SCALE: 1" = 20'-0"

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, BOTTOM ASH POND MODIFICATION PLAN, SECTIONS AND DETAILS

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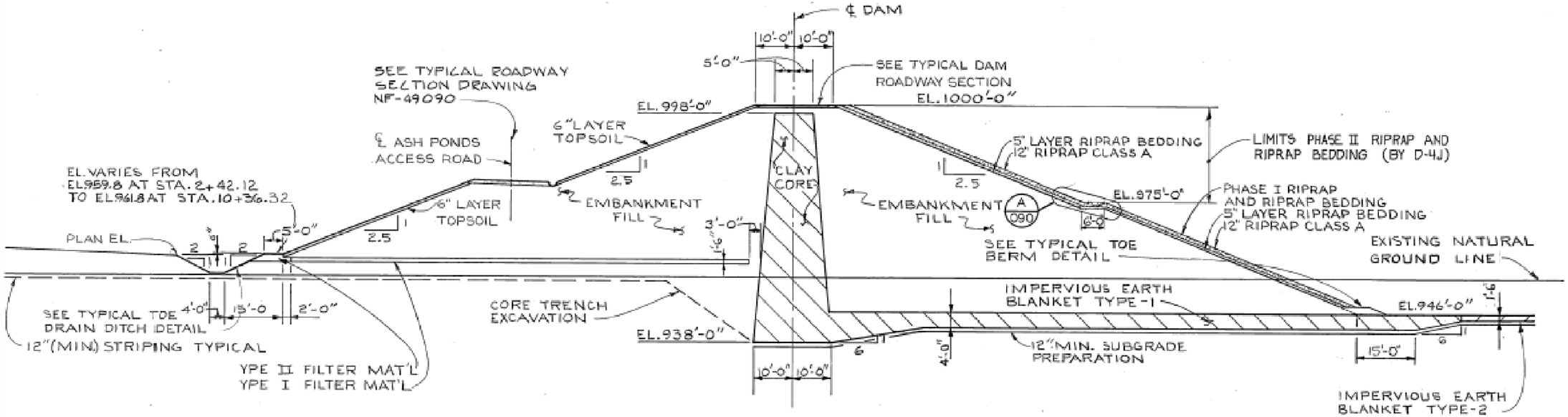
BOTTOM ASH POND TYPICAL CROSS SECTION EAST DAM
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 3D



TYPICAL WEST DAM SECTION 7
STA. 2+42.12 TO STA. 10+36.32

SCALE: 1"= 20'

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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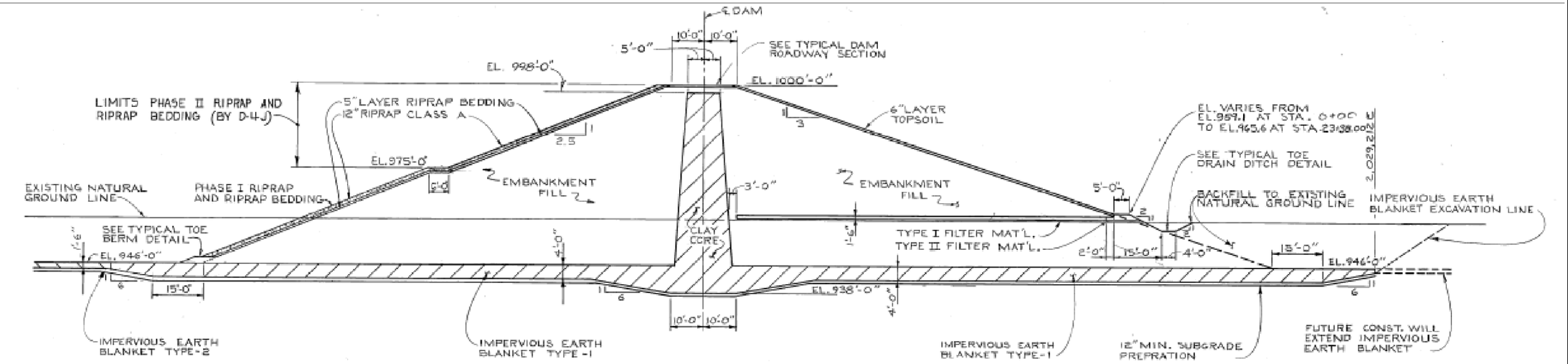
POND NO. 1 TYPICAL CROSS SECTION
WEST DAM
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 4A



TYPICAL EAST DAM SECTION 10
STA 0+00 TO STA. 23+38.00
SCALE: 1"=20'

NOTE: WHERE EXISTING NATURAL GROUND LINE IS LOWER THAN

℄ DAM

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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POND NO. 1 TYPICAL CROSS SECTION
EAST DAM
SHERBURNE COUNTY POWER STATION
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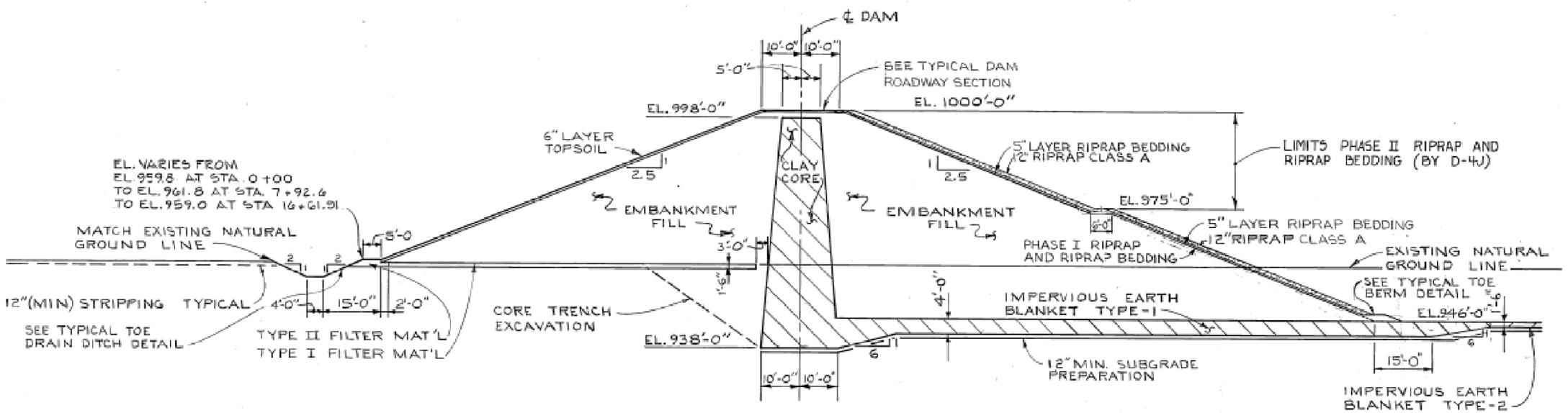
PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 4B



TYPICAL SOUTH DAM SECTION 5

STA. 0+00 TO STA. 16+61.91

SCALE: 1"=20'

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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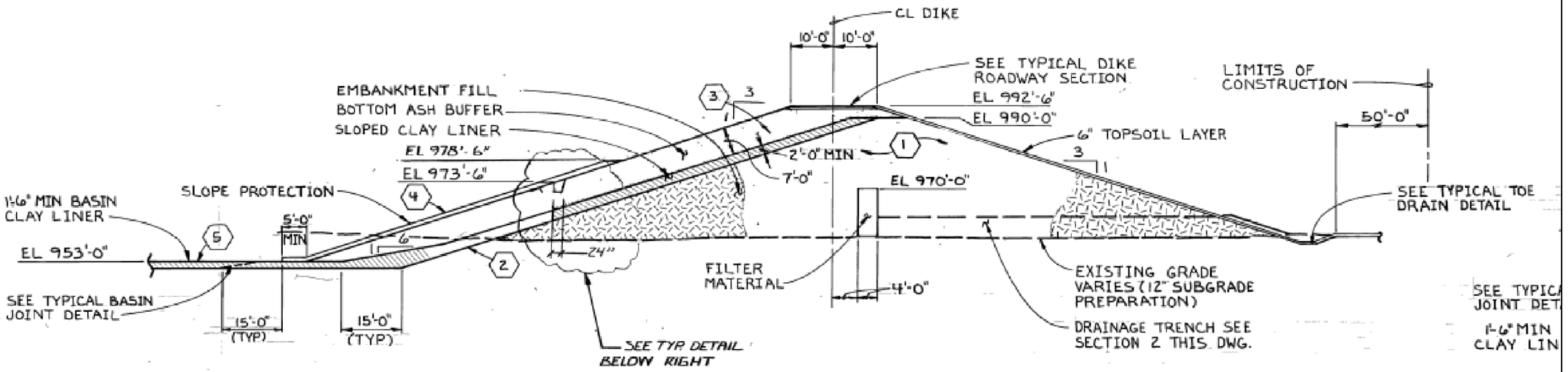
POND NO. 1 TYPICAL CROSS SECTION SOUTH DAM

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 4C



SECTION 1
SCALE: 1"=20'
DWG NF-82018

IMAGE REFERENCE: AS BUILT, REVISED DRAWING PER DWP SC-92-254, DWN: 3-6-95, PROJ: E91N055, ASH STORAGE AREA SECTIONS AND DETAILS

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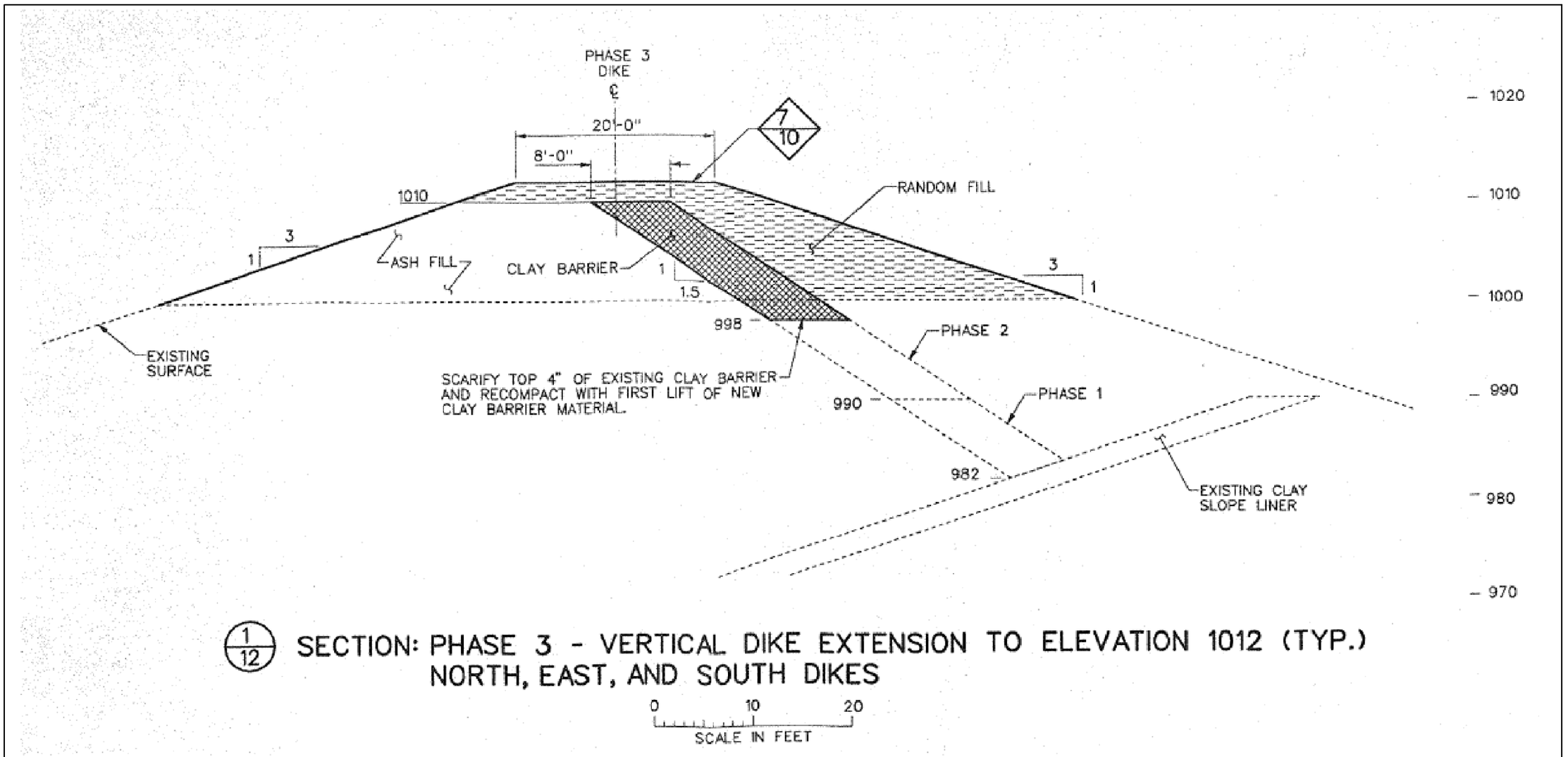
POND NO. 2 TYPICAL CROSS SECTION

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 5A



1/12 SECTION: PHASE 3 - VERTICAL DIKE EXTENSION TO ELEVATION 1012 (TYP.)
NORTH, EAST, AND SOUTH DIKES

0 10 20
SCALE IN FEET

IMAGE REFERENCE: BARR ENGINEERING CO., SHERCO POND NO. 2 VERTICAL DEVELOPMENT
PHASE 3 DIKE SECTIONS, 01-31-95

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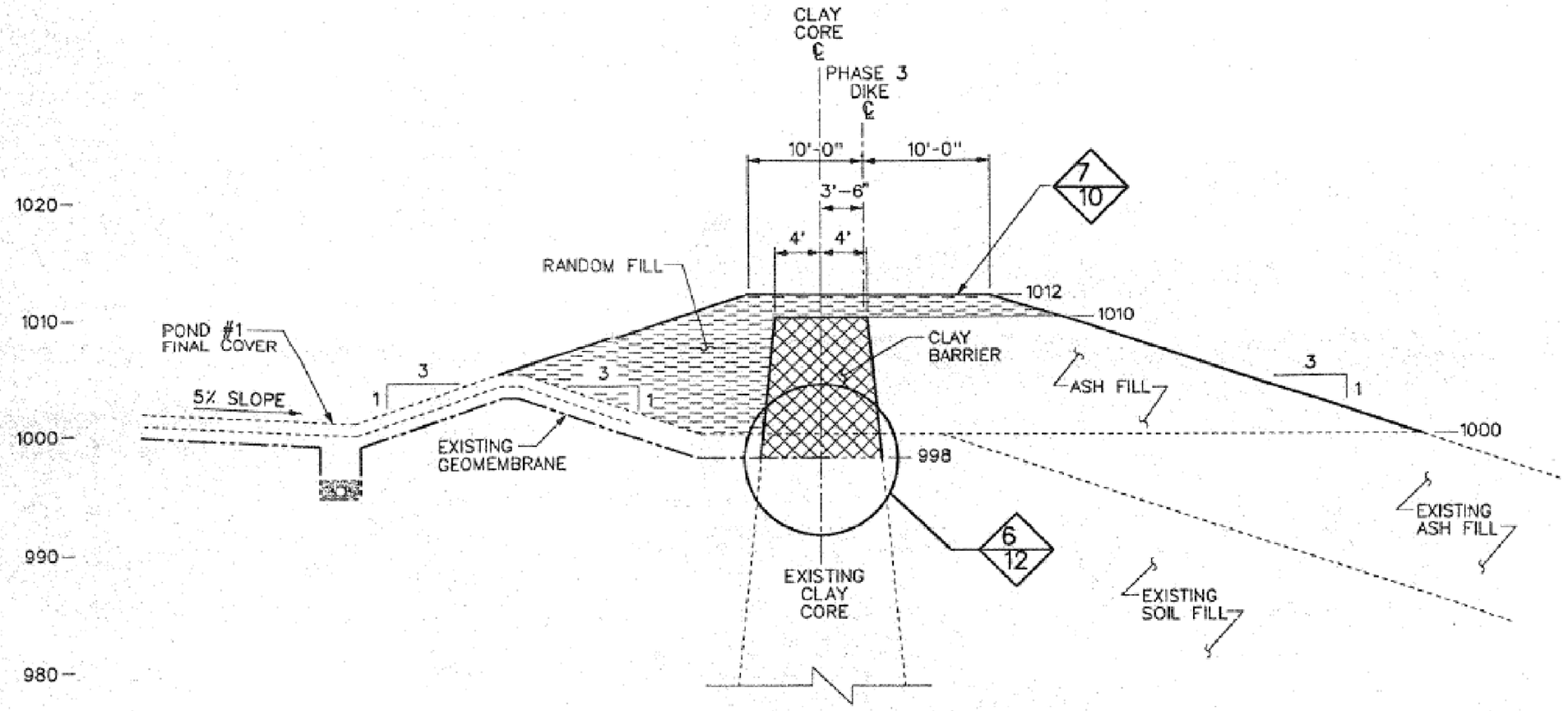
POND NO. 2 TYPICAL CROSS SECTION
VERTICAL DIKE EXTENSION
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 5B



(2/12) SECTION: PHASE 3 - VERTICAL DIKE EXTENSION TO ELEVATION 1012 (TYP.) WEST DIKE

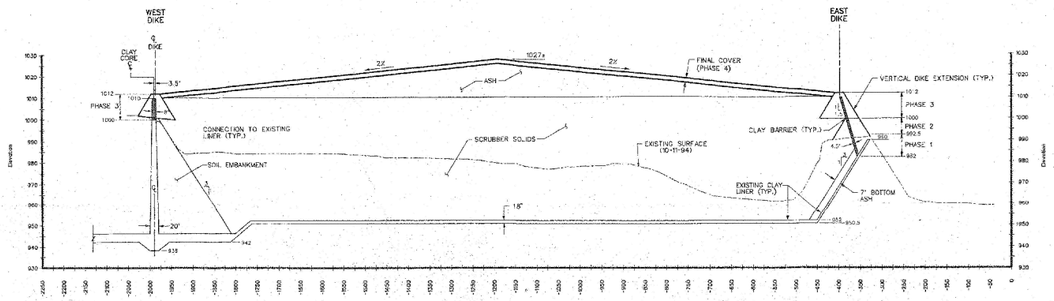
0 10 20
SCALE IN FEET

IMAGE REFERENCE: BARR ENGINEERING CO., SHERCO POND NO. 2 VERTICAL DEVELOPMENT PHASE 3 DIKE SECTIONS, 01-31-95

CHA
Albany, NY

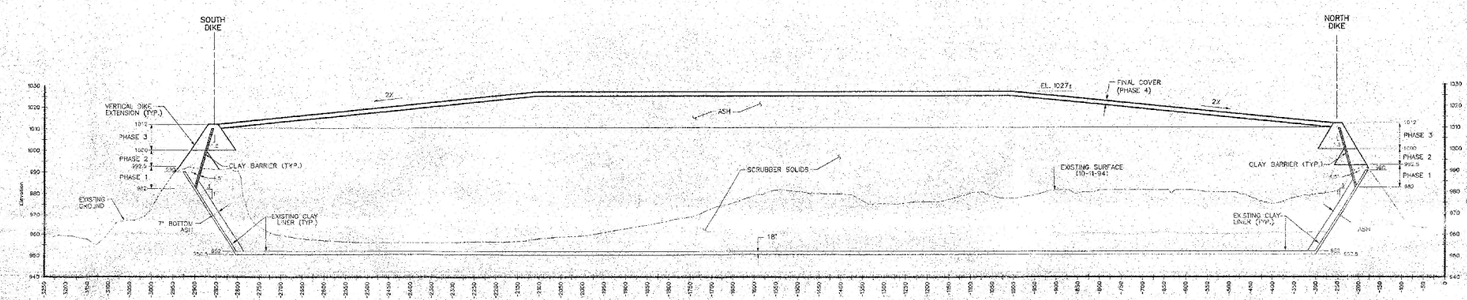
POND NO. 2 TYPICAL CROSS SECTION
VERTICAL DIKE EXTENSION
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 5C



1/4 TYPICAL CROSS SECTION EAST - WEST

HORIZONTAL SCALE 1"=100 FEET
VERTICAL SCALE 1"=20 FEET



2/4 TYPICAL CROSS SECTION NORTH - SOUTH

HORIZONTAL SCALE 1"=100 FEET
VERTICAL SCALE 1"=20 FEET

IMAGE REFERENCE: BARR ENGINEERING CO., SHERCO POND NO. 2 VERTICAL DEVELOPMENT SITE CROSS SECTIONS, 01-31-95

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POND NO. 2 VERTICAL DEVELOPMENT SITE CROSS SECTIONS

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 5D

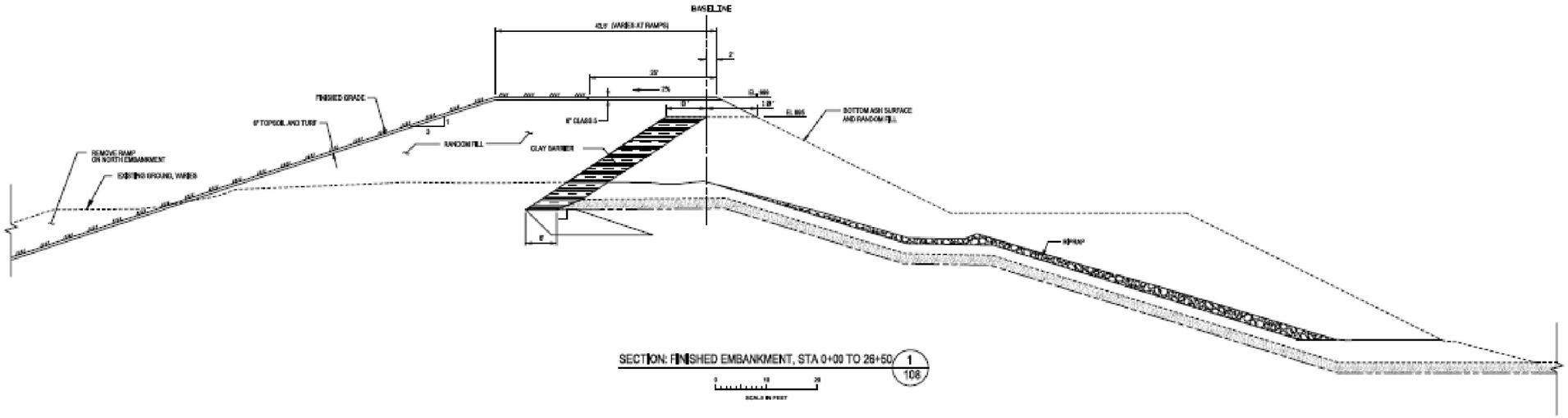

IMAGE REFERENCE: MCCAIN AND ASSOCIATES, INC., SHERBURNE COUNTY GENERATING PLANT, 2008 ASH CONSTRUCTION PROJECTS POND 3 NORTH, FINISHED GRADE SECTIONS

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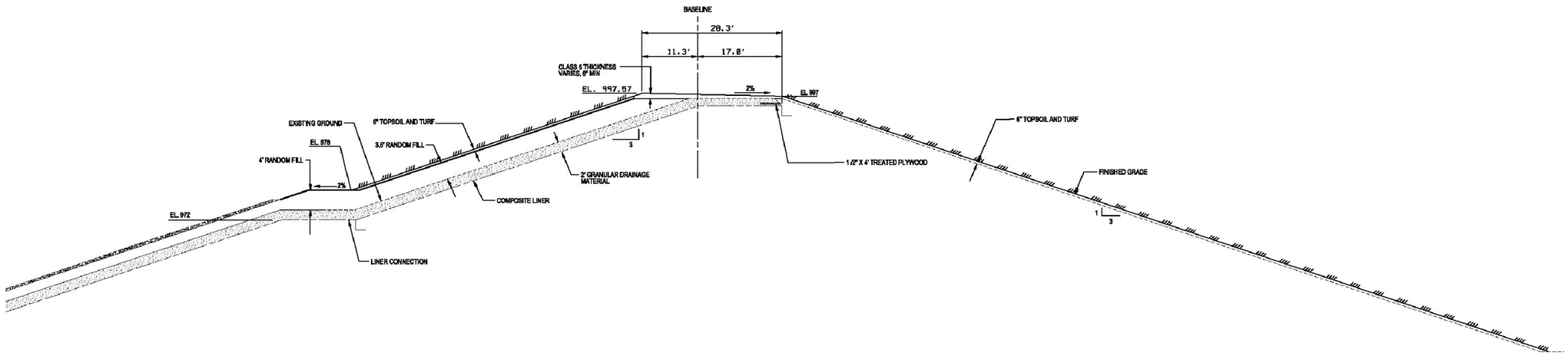
POND NO. 3N TYPICAL CROSS SECTION
NORTH AND EAST EMBANKMENTS
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 6A



SECTION: FINISHED SOUTH EMBANKMENT, STA 29+05 TO 38+35 (2/108)

IMAGE REFERENCE: MCCAIN AND ASSOCIATES, INC., SHERBURNE COUNTY GENERATING PLANT, 2008 ASH CONSTRUCTION PROJECTS POND 3 NORTH, FINISHED GRADE SECTIONS

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Main: (518) 453-4500 • www.chacompanies.com

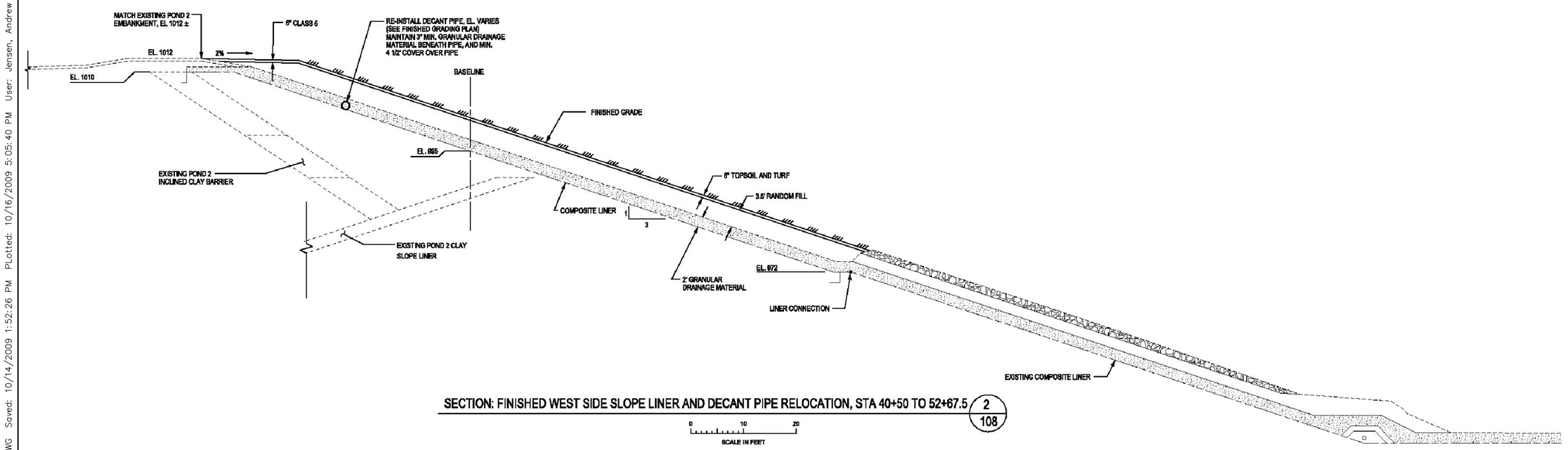
POND NO. 3N TYPICAL CROSS SECTION
SOUTH EMBANKMENT
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 6B

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_6_POND 3 TYPICAL CROSS SECTION.DWG Saved: 10/14/2009 1:52:26 PM PLotted: 10/16/2009 5:03:29 PM User: Jensen, Andrew



SECTION: FINISHED WEST SIDE SLOPE LINER AND DECANT PIPE RELOCATION, STA 40+50 TO 52+67.5 (2/108)

0 10 20
SCALE IN FEET

IMAGE REFERENCE: MCCAIN AND ASSOCIATES, INC., SHERBURNE COUNTY GENERATING PLANT, 2008 ASH CONSTRUCTION PROJECTS POND 3 NORTH, FINISHED GRADE SECTIONS

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POND NO. 3N TYPICAL CROSS SECTION
WEST SIDE SLOPE
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 6C

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_6_POND 3 TYPICAL CROSS SECTION.DWG Saved: 10/14/2009 1:52:26 PM PLotted: 10/16/2009 5:05:40 PM User: Jensen, Andrew

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CRITICAL INFRASTRUCTURE MAP

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 7

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_7_CRITICAL INFRASTRUCTURE MAP.DWG Saved: 10/16/2009 12:50:40 PM PLotted: 10/16/2009 4:25:40 PM User: Jensen, Andrew

2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3 impoundments following the general procedures and considerations contained in Federal Emergency Management Agency's (FEMA's) *Federal Guidelines for Dam Safety* (April 2004), and Federal Energy Regulatory Commission (FERC) Part 12 Subpart D to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Form, prepared by the US Environmental Protection Agency, were completed on-site during the site visit. Copies of the completed forms were submitted via email to Lockheed Martin representatives approximately three days following the site visit to the Sherburne County Power Station. Copies of these completed forms are included in Appendix A. A photo log and a Site Photo Location Maps (Figures 8A, 8B, 8C and 8D) are also located at the end of Section 2.6.

CHA's visual observations were made on September 16, 2009 and September 17, 2009. The weather was partly sunny with temperatures between 60 and 80 degrees Fahrenheit. Prior to the days we made our visual observations the following approximate rainfall amounts occurred (as reported by www.weather.com).

Table 1 - Approximate Precipitation Prior to Site Visit

Date of Site Visit – September 16, 2009		
Day	**Date**	**Precipitation (inches)**
Tuesday	09/08/09	0.00
Wednesday	09/09/09	0.05
Thursday	09/10/09	0.00
Friday	09/11/09	0.10
Saturday	09/12/09	0.00
Sunday	09/13/09	0.00
Monday	09/14/09	0.00
Tuesday	09/15/09	1.62
Wednesday	09/16/09	0.93
Total	**Week Prior to Site Visit**	**0.15 inches**

2.2 Visual Observation – Bottom Ash Pond

CHA performed visual observations of the North, West, and East Dams and the Center Dike impounding the Bottom Ash Pond. The Bottom Ash Pond was actively being dredged at the time of the site visit. Ash was being removed from the pond and placed in Pond No. 2 to construct interior dams as outlined in the closure plan for Pond No. 2.

Access roads run the entire length of the four dam crests. In general, the embankments do not show signs of change in their horizontal alignments from their proposed alignments. No evidence of prior releases, failures or patchwork on the embankments was observed at the time of the site visit. Our field observations for this impoundment are provided in Section 2.2.1.

2.2.1 Bottom Ash Pond Embankments and Crests

Animal burrows were observed along the faces and groins of the North and East Dams (Photo 4). One burrow was measured to be 24 inches deep at the groin of the East Dam (Photo 8).

There appeared to be an old vegetated scarp along the bottom one-third of the downstream slope of the North Dam near the ash lines. In addition, isolated surficial deformation/creep was noted on the downstream slope of the North Dam near the crest and where ash lines entered the pond.

Slight surface undulations were observed near the crest at the northeast corner of the West Dam. Thick vegetation was noted on the West Dam embankment and the toe drain appeared to be dry with vegetation growing.

2.2.2 Bottom Ash Pond Outlet Control Structure

The Bottom Ash Pond has a discharge structure located on the West Dam. The inlet and outlet of the structure are submerged and could not be observed during our site visit. A freeboard of 4-feet is maintained to allow for design storm storage. Because this impoundment is fully diked,

the only inflow to the pond during the design storm is that which falls on the surface of the pond, the crests and upstream slopes (the crests are generally flat to graded slightly toward the pond).

2.3 Visual Observations – Pond No. 1

CHA performed visual observations of the downstream embankment slopes of the West, South and East Dams impounding Pond No. 1. Vegetation on the embankments consists predominantly of grasses and is well maintain. The upstream embankment slopes of these dams could not be observed as the pond has been capped in accordance with the approved closure plans.

In general, the downstream embankment slopes do not show signs of change in their horizontal alignments from their proposed alignments. No evidence of prior releases, failures or patchwork on the embankments was observed at the time of the site visit. Our field observations for this impoundment are provided in Section 2.3.1.

2.3.1 Pond No. 1 Embankments and Crests

Animal burrows were observed on the downstream slope of the West and South Dams. On the South Dam slope approximately two-thirds the distance along the dam a 4.5-foot deep animal burrow was observed (Photo 24). In the West Dam slope surface undulations were observed possibly caused by animal burrow initiated creep.

On the West Dam an area of minor erosion/toe scarp was observed in the ditch adjacent to the rock lined outfall ditch. Erosion was also observed at the mid-slope of the embankment and is likely due to runoff from the access road above (Photo 34). At approximately three-quarter distance from southwest corner of the dam a 6-foot wide gulley, 2-foot deep formed in surface of slope in area of surface undulation (Photos 35 and 36). This surficial slope deformation/creep is

again likely due to substantial animal (i.e. pocket gophers, foxes, etc.) activity noted on the West Dam.

On the South Dam a 48-inch wide, 3-foot deep sinkhole was observed near the crest at the storm line (Photo 22). On the dam, erosion/rills were noted approximately 30 feet and 50 feet west due to crest road runoff (Photo 23). Approximately 30 feet east of southwest corner of the dam a erosion/sinkhole was observed near the crest. Numerous tree stumps greater than 4 inches in diameter were observed indicating that the trees had been recently cut.

A partially vegetated toe drain was observed at the bottom of the East Dam embankment slope. The toe drain appeared to be dry with no moisture observed. There was an area of sand exposed at toe. The rip-rap lined drain channel was noted to contain vegetation.

The pond dewatering system outfalls were observed to be active during the site visit.

2.3.2 Pond No. 1 Outlet Control Structure

Pond No. 1 is capped and permanently closed and therefore there is no outlet control structure. There are active dewatering system outfalls at various locations around the perimeter on the capped pond.

2.4 Visual Observation – Pond No. 2

CHA performed visual observations of the North, West, South and East Dams impounding Pond No. 2. Approximately 40% of the pond has been closed and capped with a geomembrane liner. At the time of the site visit the elevation of the water in the active part of the pond was at approximately elevation 1,008 feet. The freeboard was observed to be approximately 4 feet.

There are access roads that run the entire length of the dam crests. In general, the embankments do not show signs of change in their horizontal alignments from their proposed alignments. No evidence of prior releases, failures or patchwork on the embankments was observed at the time of the site visit. Our field observations for this impoundment are provided in Section 2.4.1.

2.4.1 Pond No. 2 Embankments and Crests

Animal burrows were noted near the crest of the North Dam and on the East Dam. The burrows were measured to be approximately 4 to 6 inches deep (Photos 41 and 42) near the crest of the North Dam.

Erosion was observed on North Dam face near the crest at the corner between Ponds No. 2 and No. 3 (Photos 50 and 51). Isolated erosion/ground cover loss was noted at the North Dam downstream slope where erosion protection is absent.

The crest of the South Dam was measured to be approximately 40 feet wide. A silted-in culvert end section was observed near the toe of the dike. Lush vegetation was noted at toe of the dam in this area.

Along the South Dam erosion rills were observed from the access road ramp. Erosion was also observed on the crest road of the East Dam at the location adjacent to Pond No. 3N. Isolated erosion/ground cover loss on the East Dam downstream slope where erosion protection was absent was also noted.

Trees were observed on the East Dam slope in area of future Pond 3S. The trees are to be removed as part of Pond No. 3S construction planned in 2010.

Although not observed during our recent site visit, significant seepage was noted by MN DNR Dam Safety during a July 2009 inspection of Pond No. 2 along the eastern side of the southern

pond where water levels appear to have risen higher than the embankment's clay core. Seepage sites included visibly flowing water with some rills and gullies forming on the embankment. Dam Safety did not consider this seepage to be serious due to the small volume of water in the ponds, that the ponds will be filled and capped in the near future, and any materials from an embankment failure would be into the area to be occupied by the future Scrubber Pond No. 3S.

Pond No. 2 contains a temporary interior dam which was measured to be approximately 17 feet wide. The freeboard measured approximately 1.5 feet. Erosion was observed along the interior dam slope.

2.4.2 Pond No. 2 Outlet Control Structure

Pond No. 2 has a discharge structure located on the North Dam. The inlet and outlet of the structure are submerged which precluded direct observations. The impoundment is fully diked therefore the only inflow to the pond during the design storm is that which falls on the surface of the pond, the crests and upstream slopes (the crests are generally flat to graded slightly toward the pond).

2.5 Visual Observation – Pond No. 3

CHA performed visual observations of the North, East and South Embankments and the West Side Slope impounding Pond No. 3N.

There are access roads that run the entire length of the embankment crests. In general, the embankments do not show signs of change in their horizontal alignments from their proposed alignments. No evidence of prior releases, failures or patchwork on the embankments was observed at the time of the site visit. Our field observations for this impoundments are provided in Section 2.5.1.

2.5.1 Pond No. 3N Embankments and Crests

Erosion control netting was observed on the North Embankment slope. The presence of the netting appeared to reduce the number of animal burrows in the slope. Animal burrows were observed on the West Side Slope.

On the North and East Embankments very slight wave erosion was observed on the upstream embankment slopes where bottom ash and sand/gravel slope surfaces have not been vegetated. A loss of grass cover was observed on the West Side Slope adjacent to the outlet structure.

2.5.2 Pond No. 3 Outlet Control Structure

Pond No. 3 has a discharge structure located at the west corner of the North Embankment. At the time of the site visit the elevation of the water in the pond was at approximately 982 feet and there was approximately 15 feet of freeboard. The inlet and outlet were submerged precluding direct observation. Clarified water from the pond is recycled through plant for ash sluicing and FGD scrubber sluicing.

2.6 Monitoring Instrumentation

There are piezometers installed in Pond No. 1 and Pond No. 2.

Pond No. 1 has monitoring wells installed through the cap of the closed pond to measure groundwater quality and the effectiveness of the dewatering activities initiated since the pond was closed and capped in 1995.

Pond No. 2 and Pond No. 3 have vertical and inclined dewatering wells that will be activated when the ponds are capped and closed.

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

CHA
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PHOTO LOCATION MAP
BOTTOM ASH POND
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 8A

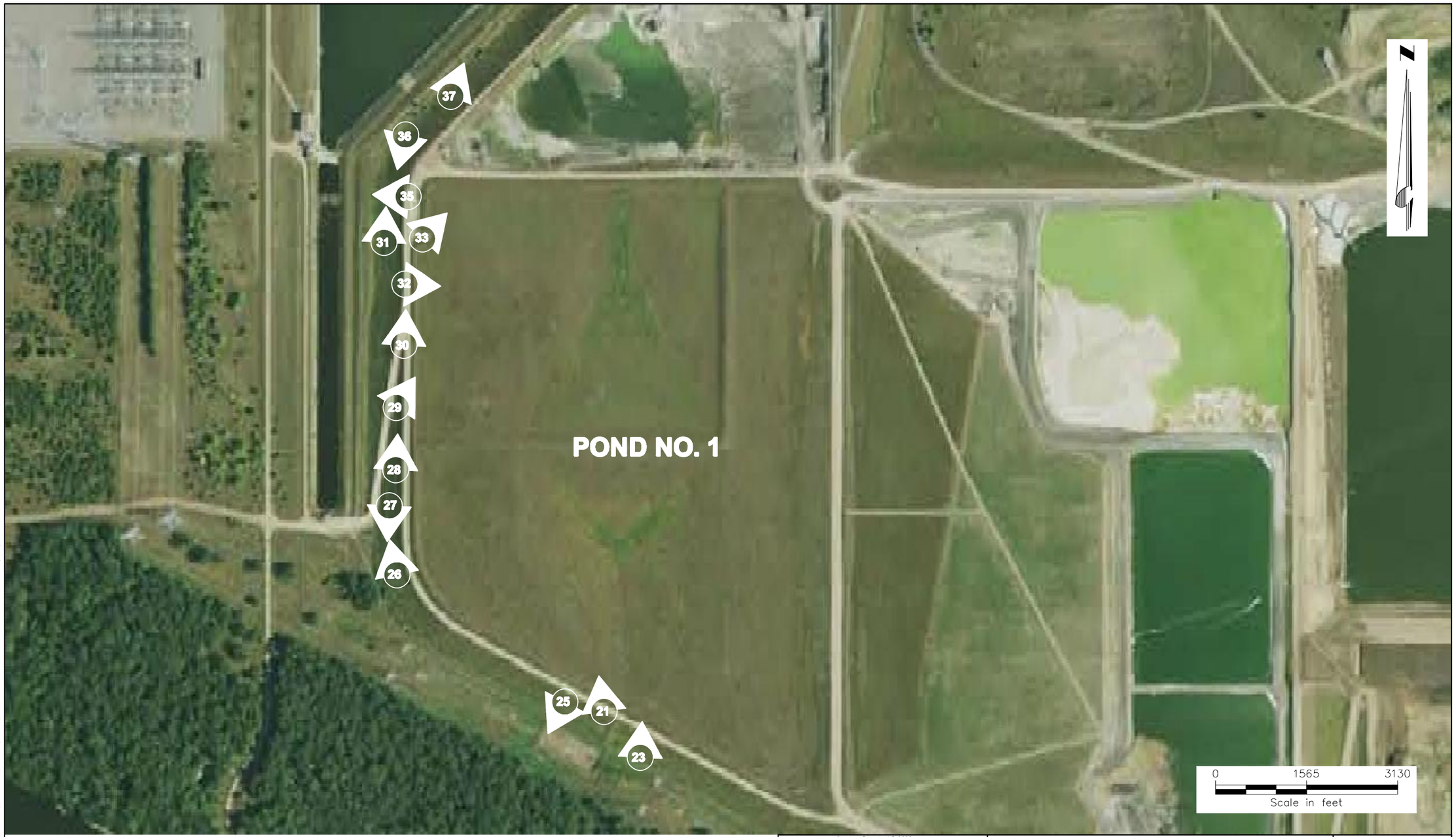

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

CHA

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PHOTO LOCATION MAP
POND NO. 1
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 8B

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

CHA
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Main: (518) 453-4500 • www.chacompanies.com

PHOTO LOCATION MAP
POND NO. 2
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 8C

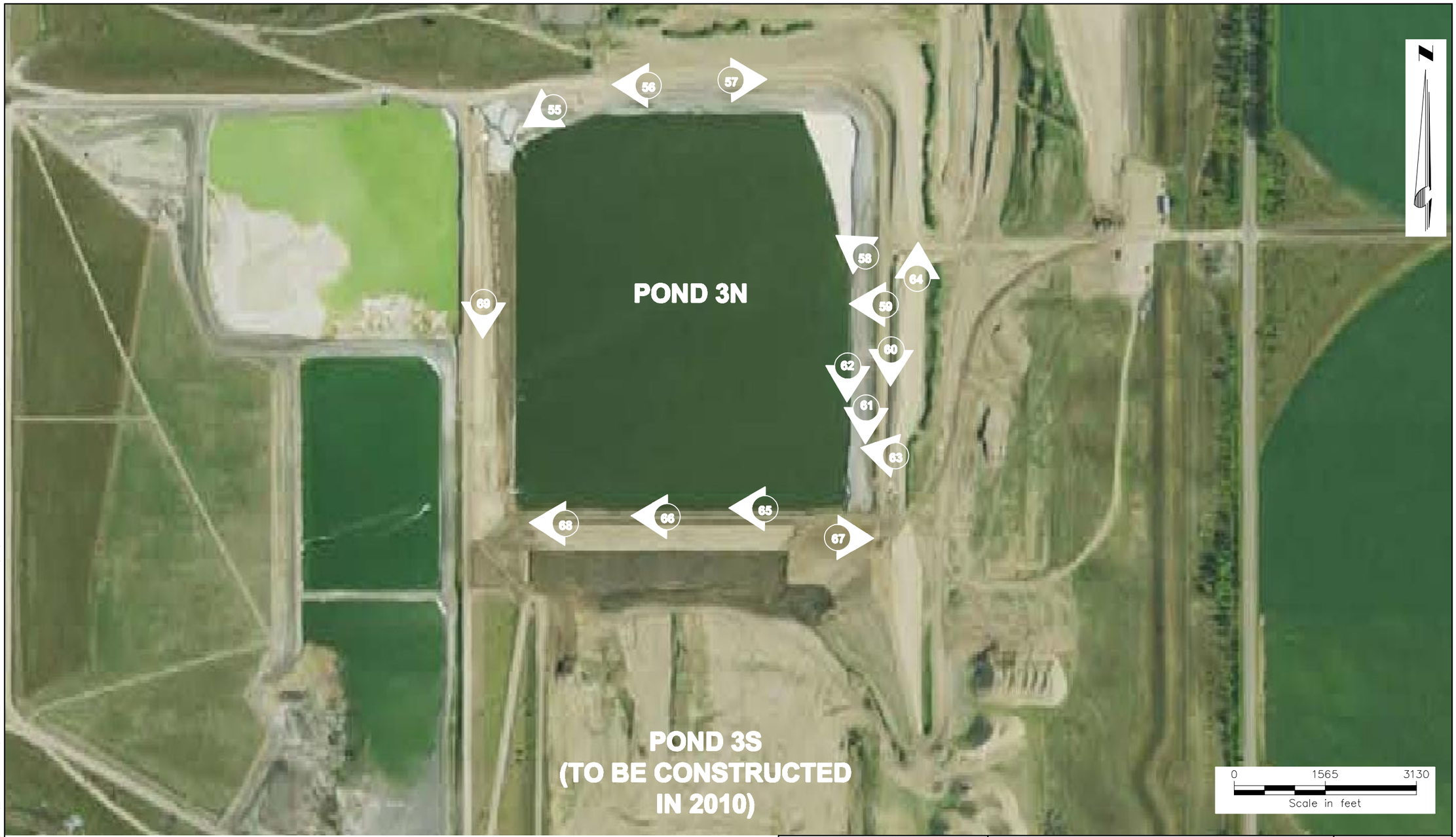

IMAGE REFERENCE: GOOGLE EARTH, IMAGERY DATED SEPTEMBER 20, 2004.

CHA

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PHOTO LOCATION MAP
POND NO. 3
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

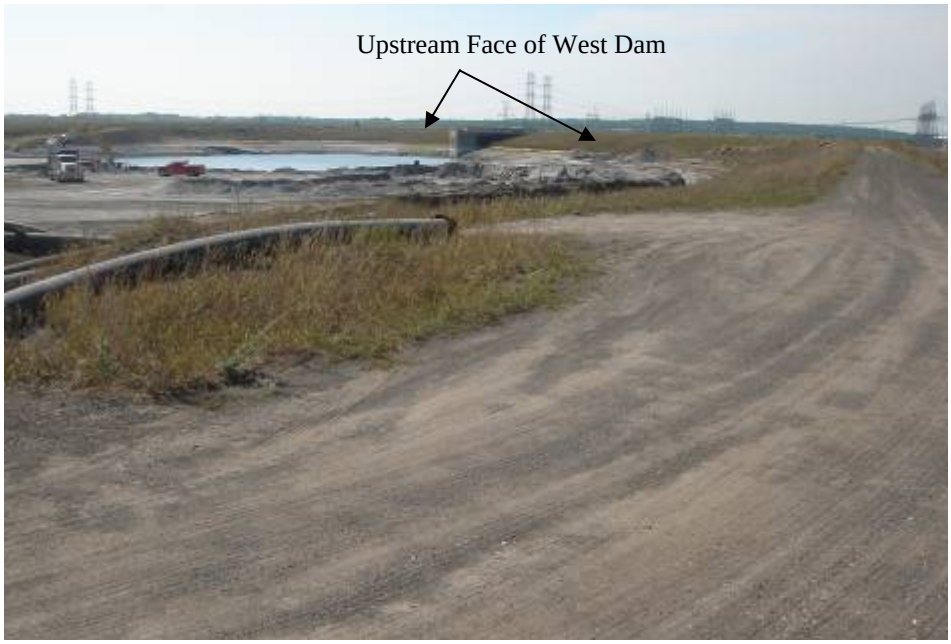
DATE: 10/16/09

FIGURE 8D

1

Intersection of downstream embankment slopes of North and East Dams, looking northwest.

2



Upstream embankment slope of West Dam, looking west.

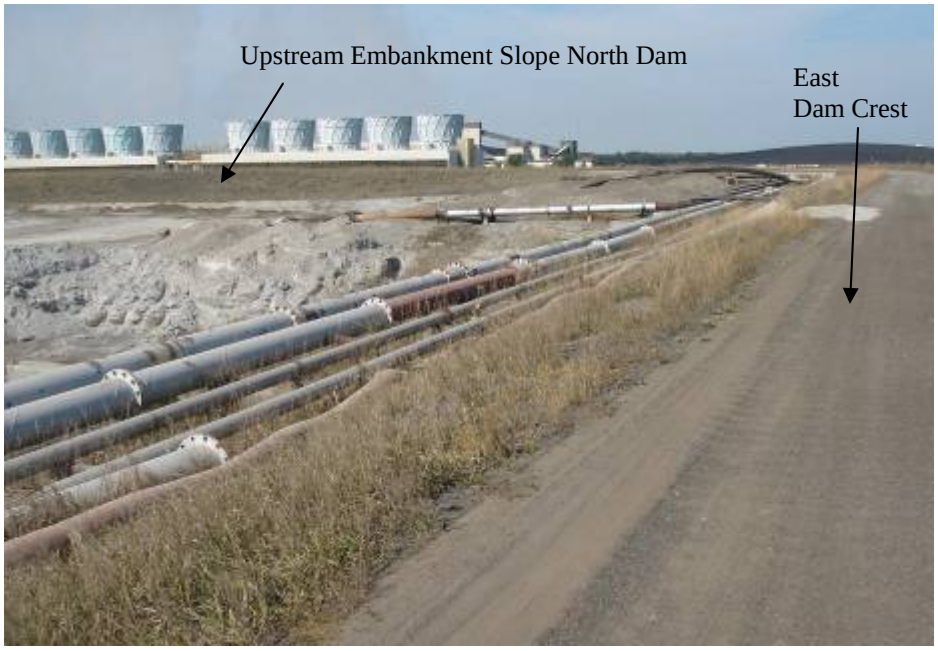
3

Upstream embankment slope of East Dam, looking south.

4

Animal burrow in East Dam.

5



Upstream embankment slope of North Dam and crest of East Dam, looking northwest.

6

Downstream embankment slope of East Dam, facing north.

7

Downstream embankment slope of East Dam at south end of slope (groin), looking southeast.

8

Animal burrow in East Dam near groin. Burrow was measured to be approximately 2’-4” deep from the ground surface.

9

Looking across Bottom Ash Pond from the West Dam.

10

Downstream embankment slope West Dam, facing northeast.

11

Upstream embankment slope of West Dam, facing northeast.

12

Looking across Bottom Ash Pond at upstream embankment slope of Dam between Bottom Ash Pond and Pond 1.

13

Upstream embankment slope of North Dam, facing east at corner of West and North Dams.

14

Crest of North Dam, facing east.

15

Upstream embankment slope of North Dam, facing east at corner of West and North Dams.

16

Downstream embankment slope of West Dam, facing northwest.

17

Downstream embankment slope and crest of North Dam, facing northwest.

18

Upstream embankment slope of North Dam, facing west.

19

Upstream embankment slope and crest of North Dam, facing east.

20

Downstream embankment slope of North Dam, facing east at corner of North and East Dams.

21

View across Pond 1 cap, facing northwest from South Dam.

22

48-inch diameter, 3-foot deep sink hole near crest of South Dam.

23

Erosion observed on downstream embankment slope of South Dam.

24

Animal burrow on embankment slope of South Dam.

25

Drainage along downstream embankment slope of South Dam.

26

Downstream embankment slope of West Dam, facing north.

27

Downstream embankment slope of West Dam, facing south.

28

Downstream embankment slope and crest of West Dam.

29

View across Pond 1 cap from West Dam, facing northeast.

30

Downstream embankment slope of West Dam, facing north.

31

Downstream embankment slope of West Dam, facing north.

32

View across Pond 1 cap from West Dam, facing east.

33

View across Pond 1 cap from West Dam, facing northeast.

34

Erosion observed at mid-height on downstream embankment slope of the West Dam.

35

Downstream embankment slope of West Dam, facing west. Note surface undulations observed.

36

Downstream embankment slope of West Dam, facing south.

37

Downstream embankment slope of West Dam, facing north.

38

Drainage inlet in Pond 1 cap, looking east.

39

Pond 2 filling operations, facing northeast.

40

Downstream embankment slope of North Dam, looking east.

41

Animal burrows on downstream embankment of North Dam.

42

Animal burrows on downstream embankment of North Dam.

43

Downstream embankment slope of North Dam, looking northwest.

44

Partially filled portion of Pond 2, facing southwest.

45

Partially filled portion of Pond 2, facing south.

46

Active potion of pond, facing south.

47

Temporary Dam in Pond 2, facing south.

48

Outlet structure for Pond 2, facing east.

49

Downstream embankment slope of North Dam, facing east.

50

Minor erosion at top of downstream embankment of North Dam, facing northwest.

51

Minor erosion on downstream embankment slope of North Dam.

52

Looking across Pond 2 from Temporary Dam, facing northwest.

53

Downstream embankment slope and crest of East Dam adjacent to Pond 3S, facing south.

54

Downstream embankment slope and crest of South Dam, facing west.

54A

Erosion of Pond No. 2 upstream embankment, facing south west.

54B

Erosion of Pond No. 2 upstream embankment, facing west.

CHA	**NORTHERN STATES POWER COMPANY SHERBURNE COUNTY POWER STATION POND NO. 2 BECKER, MN**
CHA Project No.: 20085.2010.1510	September 16, 2009

55

Upstream slope of North Embankment and outlet works, facing west.

56

Upstream slope and crest of North Embankment, looking west.

57

Upstream slope of North Embankment, facing east.

58

Looking across Pond 3N at the upstream slope of the North Embankment, looking northwest.

59

Looking across Pond 3N at the West Side Slope, facing southwest.

60

Downstream slope of East Embankment, looking south.

61

Downstream slope of East Embankment, facing south.

62

Crest and upstream slope of East Embankment, facing south.

63

Looking across Pond 3N at West Side Slope, facing northwest.

64

Downstream slope of East Embankment, facing north.

65

South Embankment of Pond 3N which separated Pond 3N and 3S.

66

Downstream embankment slope of Dam between Pond 3N to Pond 3S, facing west.

67

Downstream slope of Embankment between Pond 3N to Pond 3S, facing east.

68

Groin at Ponds 3S and Pond 2, facing west.

69

Upstream slope of Embankment between Pond 3N to Pond 2, facing south.

3.0 DATA EVALUATION

3.1 Design Assumptions

CHA has reviewed the design assumptions related to the design and analysis of the stability and hydraulic adequacy of the Bottom Ash Pond, Pond No.1, Pond No. 2 and Pond No. 3 impoundments, respectively, which were available at the time of our site visits and provided to us by NSPC. The design assumptions are listed with the applicable summary of analysis in the following sections.

3.2 Hydrologic and Hydraulic Design

The Bottom Ash Pond, Pond No. 2 and Pond No. 3 are structures that qualify under the MNDNR dam safety regulations as Class II (Significant) Hazard Classification. Based on these criteria the impoundments are required to pass the full Probable Maximum Precipitation (PMF) without overtopping, based on the Minnesota Dam Safety Laws and Regulations 2007.

CHA preformed a hydrologic and hydraulic assessment for the Bottom Ash Pond, Pond No. 2 and Pond No. 3. The analysis was used to confirm that the ponds will adequately store the volume generated during the Probable Maximum Flood (PMF) event. The PMF of 22.98 inches was generated using basin characteristics, information gathered from the HMR-51 and 52, and the HMR Boss Program. The entire watershed contained 172± acres which consisted of open space, pond/basin, capped landfill, and impervious areas. A hydrograph was generated based on the calculated time of concentration and curve numbers, using TR-55 Methodologies. Rainfall amounts for the 2-year and 100-year events were referenced from the NRCS Rainfall Distributions Atlas. Table 2 summarized the results. The assessment of the Bottom Ash Pond, Pond No. 2 and Pond No. 3 indicates that the ponds will adequately store the volumes generated during the Probable Maximum Flood (PMF).

Table 2 – Summary of Hydrologic and Hydraulic Assessment

Pond	Peak Flow Rate In (cfs)	Peak Flow Rate Out (cfs)	Peak WSE (ft)	Top of Pond Elev. (ft)	Freeboard (ft)	Bottom of Pond Elev. (ft) (assumed)	Normal Pool Elevation* (ft)
Bottom Ash Pond	321	164	979.8	1,000	20.2	946.0	975.0[1]
Pond No. 2	1652	61	1011.0	1,012	1.0	952.5	1008.0[2]
Pond No.3[3]	858	0	984.3	997	12.7	980.0	982.0

[1] Normal pool in the Bottom Ash Pond was assumed to be approximately 975.0 based on record plans and site photos. This elevation is subject to change due to dredging operations.
[2] Normal pool in Pond No. 2 was assumed at 1008.0 ft based on a 4-5 ft depth of freeboard noted in the site visit. This elevation is subject to change due to filling operations.
[3] Pond No. 3 was modeled to have no outlet structure as water is generally pumped from the basin to the facility for reuse.

3.3 Structural Adequacy & Stability

The MNDNR Division of Water, Dam Safety Program recognizes industry guidelines such as those published in the US Army Corps of Engineers (USACOE). USACOE Engineering Manual (EM) 1110-2-1902, Table 3-1 suggests the following guidance values for minimum factors of safety as shown in Table 3.

Table 3 - Recommended Minimum Safety Factors Recommended by USACOE

Analysis Condition	Recommended Minimum Factor of Safety	Slope
Long-term	1.5	Downstream and Upstream
Maximum surcharge pool	1.4	Downstream
Rapid drawdown	1.3	Upstream
Seismic	1.0	Downstream
Liquefaction	1.3	NA

In Sections 3.3.1 through 3.3.4 we discuss our review of the effects of overtopping, stability analyses, and performance of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3, respectively.

3.3.1 Bottom Ash Pond

CHA was provided with the original design report for the Bottom Ash Pond. The *Sherburne County Generating Plant Unit No. 1 and Unit No. 2 Project Outline – Earth Retaining Structures for Coal, Water and Ash Storage Supporting Analysis II-M* report prepared by Black & Veatch Consulting Engineers and dated June 27, 1973 provides a stability analyses of the discharge of the bottom ash pond and the embankments. In Section 4.0 of the report the results of the stability analyses for each embankment section is presented. The analyses were performed in accordance with general design methods described as the Limiting Equilibrium Approach as developed by Bishop and adapted to computer solution. Stability analyses were performed with and without earthquake loadings. The earthquake loading used in the analysis was a horizontal force with a magnitude expressed as a percentage of gravity. A factor of safety of 1.1 was considered acceptable for stability analyses using an earthquake loading of 10 percent of gravity.

Table 4 summaries the soil strength parameters used for the stability analyses.

Table 4 - Soil Strength Properties for Bottom Ash Pond and Pond No. 1

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
SP-SM Embankment	136	35	0
CL Core	120	0	1,000
Filter	120	35	0
SP-SM Foundation (Relative Density 60%)	133	30	0

In July 1973 Dames & Moore Consulting Engineers (Dames & Moore) at the request of NSPC prepared *Report of Review of Design Criteria and Project Specifications, Proposed Coal and Ash Storage Area, Sherburne County Generating Plant – Unit 1.* Dames & Moore received copies of the supporting analyses, boring logs and laboratory test data to review from Black & Veatch. The report noted that soil parameters for the design of the dams included the following;

- In-situ Natural Soils and on-site cohesionless embankment fill material – density, angle of internal friction, and permeability.
- Impervious core and impervious blanket – density, shear strength, and permeability.
- Filter blanket – density, gradation, angle of internal friction and permeability.

It was also noted that soil parameters used in the analyses were based on field and laboratory tests. Dames & Moore stated the following in their report.

"The soil parameters and loading conditions used in these analyses have been conservatively chosen. Selected critical cases, including full reservoir with earthquake loading, have been verified by Dames & Moore. Those loading cases which were not specifically verified are less critical and the computed factors of safety appear to be reasonable and consistent.

The factors of safety for the slopes used in the design are adequate to ensure the safety of the structures. Moreover, the computed factors of safety probably represent lower bound values in view of the conservative assumptions of soil parameters and loading conditions used in the analyses."

The resulting computed factors of safety from Black & Veatch's analyses are summarized in Table 5.

Table 5 - Summary of Safety Factors from Bottom Ash Pond and Pond No. 1

Load Case	Recommended Minimum Factor of Safety	Calculated Minimum Factor of Safety
West Dam – Downstream Slope (2H:1V)		
Full Reservoir Elevation 996 feet	1.4	1.8
Full Reservoir with Earthquake Loading	1.0	1.4
West Dam – Upstream Slope (2H:1V)		
Rapid Drawdown to Elevation 970 feet	1.3	1.4
East Dam – Downstream Slope (3H:1V)		
Full Reservoir Elevation 996 feet	1.4	1.8
Full Reservoir with Earthquake Loading	1.0	1.3
East Dam – Downstream Slope (2H:1V)		
Rapid Drawdown to Elevation 970 feet	1.3	1.4
Center Dam – Downstream Slope (2.75H:1V)		
Full Reservoir Elevation 996 feet	1.4	1.8
Full Reservoir with Earthquake Loading	1.0	1.2
Center Dam – Downstream Slope (2.75H:1V)		
Rapid Drawdown to Elevation 970 feet	1.3	1.7

The computed factors of safety were found to be acceptable by Black & Veatch. The factors of safety are greater than the recommended minimum factor of safety as outlined by the USACOE and as shown in Table 2. Figures 10A through 10D show details of these analyses.

It does not appear that an updated stability analysis was performed for the modifications that occurred in 1982 when the northeast corner of the pond was raised 25 feet to match the crest at Elevation 1000 feet. As previously noted onsite soils were used for the embankment construction and a 10-foot thick central clay core was constructed. A letter to NSPC from Black & Veatch dated June 18, 1982 noted that Black & Veatch performed an in-house independent review of the proposed modification of the Bottom Ash Pond to confirm that the design and specifications were in accordance with the design requirements of the original pond dams that was performed by Black & Veatch. It was noted in the letter that *"the design was adequate and there was a very remote possibility of failure"*.

3.3.2 Pond No. 1

The stability of the perimeter dams of Pond No. 1 were originally analyzed in the *Sherburne County Generating Plant Unit No. 1 and Unit No. 2 Project Outline – Earth Retaining Structures for Coal, Water and Ash Storage Supporting Analysis II-M* report prepared by Black & Veatch Consulting Engineers and dated June 27, 1973. Pond No. 1 is referred to as the Fly Ash Pond in the report. The stability of the Bottom Ash Pond and Pond No. 1 were analyzed together using the same soil strength parameters and geometry. A summary of soil strength parameters is provided in Table 4 and the computed factors of safety are summarized in Table 5. The computed factors of safety were found to be acceptable by Black & Veatch. The factors of safety are greater than the recommended minimum factor of safety as outlined by the USACOE and as shown in Table 2.

CHA was not provided with a copy of the final modification permit application package for capping and permanently closing the pond. We were however provided with and reviewed the report titled *Geotechnical Exploration and Preliminary Design of Vertical Expansion Landfill* prepared by Twin City Testing Corporation (Twin City) and dated February 13, 1989. Stability analyses results were presented in the report for two options to increase the storage capacity of the pond; constructing a landfill above the previously deposited ash (scrubber solids) or constructing dams upstream of the original embankments and continuing to deposit slurried scrubber solids directly into the pond. Based upon our review of drawings from the two phases of construction for capping the pond (1990 and 1995 construction) it appears that the second option is more representative of existing conditions.

Design parameters selected for the analyses performed by Twin City were based upon data from laboratory testing in conjunction with piezocone soundings for the ash (scrubber solids) properties and review of design parameters from the initial design of the pond for the embankment and clay liner properties. The strength of the foundation sands were estimated

from original borings. A summary of the parameters used in the stability analyses is provided in Table6.

Table 6 - Soil Strength Properties for Pond No. 1 Vertical Expansion Landfill

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
New Scrubber Solids	80	30	0
Embankment Sand	118	34	150
Sluiced Scrubber Solids	80	30	150
Foundation Sand - Medium Dense	121	30	0
Foundation Sand - Medium Dense	135	35	0
Bedrock - Granite	140	45	0
Clay Liner	120	23	0

The results of the stability analyses are shown on Figure 11. The stability analysis for using the upstream construction was limited to evaluating the final stability assuming that five upstream lifts have been constructed with the top of the final lift at elevation 1,085 feet. Assumptions were made that newly placed scrubber solids would consolidate and behave similarly to the existing scrubber solids. The water level was assumed to be at elevation 1,075 feet. Analyses were performed to estimate the stability assuming a higher water level would increase pore pressures in the existing scrubber solids. Additional analyses were performed assuming the higher water level would not cause higher pore pressures in the existing scrubber solids.

The assumption used for the influence of the water elevation at 1,075 feet on the existing scrubber solids dictated whether the design was acceptable. If the water level at elevation 1,075 feet is considered to increase pore pressure in the existing solids, the factor of safety was calculated to be 0.9. If the existing scrubber solids are assumed to not have higher pore

pressures as a result of the higher water level the factor of safety is calculated to be 1.6, which is above the generally accepted factor of safety of 1.5. It was recommended in the report prepared by Twin City that the use of an impermeable liner/cap above the existing scrubber solids and dewatering would prevent the higher water level from increasing pore pressures within the existing scrubber solids. Pond No. 1 has been capped with 60-mil HPDE geomembrane and dewatering wells have been installed and are actively dewatering the pond.

3.3.3 Pond No. 2

CHA reviewed the report and appendices constituting the application for amendment of the NPDES Permit for the facility in regards to Pond No. 2 dated January 1995 and prepared by Barr Engineering Company. The amendment was sought for vertical development of existing Pond No. 2. The modification included raising the existing dams to elevation 1012 feet, filling the pond with sluiced solids to elevation 1008 feet, placing additional dry ash to create a sloped fill surface on the pond, and constructing a final cover system and surface water runoff control features. Modifications also included a dewatering system for the pond with wells placed at approximately 500-foot intervals on the pond perimeter.

Vertical development of Pond No. 2 involved the placement of liner and cover materials above preexisting ash. Barr Engineering Company evaluated the following geotechnical issues as part of the report submitted with the application for permit amendment; exterior slope stability and overall dam stability, interior slope stability, overall stability of the discharge structure, uplift on the clay liner, settlement and tensile strain of the clay liner, settlement of the cap and dewatering effects on the barrier layer of the cap.

As part of the scope of work performed by Barr Engineering borings were advanced in the ash waste and perimeter dams. Field testing included vane shear tests and two field loading tests were performed to evaluate the strength and deformation properties of the ash. Laboratory testing of retrieved samples was also performed to aid in developing design parameters.

Analyses for potential failure through the exterior dam toe and through the clay liner extension was completed in the stability evaluation by Barr Engineering. The factor of safety for potential failure through the exterior dam toe was calculated to be 1.7 for static loading conditions and 1.5 for seismic loading conditions, both of which were found to be acceptable. Analyses indicated that a factor of safety of 1.5 exists for perimeter dam sections interior to the pond for the vertical development design which was also considered acceptable.

The design parameters used in the analysis are provided in Figure 12A and a summary of the analyses results is provided in Figure 12B through 12D show the stability analysis results.

The vertical development design was found by Barr Engineering to provide a suitable factor of safety with respect to uplift for the maximum pond elevation. Uplift pressure was found to be greatest at the bottom of the clay liner extension where the tie-in was made to the existing clay liner or core. The tie-in elevation of 982 feet was determined to provide an uplift factor of safety of 1.3 along all sections of the perimeter dams. The report did note that three locations would require the placement of additional overburden on the exterior slope during the final phase of construction to provide a sufficient factor of safety; the northwest corner tie-in, the southwest corner tie-in and the discharge structure tie-in.

On September 14, 2009 McCain and Associates, Inc. prepared a memorandum to NSPC compiling the stability analysis reports and resultant design drawings showing dam alignments and typical sections for the interior diking system from their project files.

The stability analysis was performed in March 2003 using SlopeW software (Spencer Method). The analysis considered the construction of new bottom ash dams over previously deposited scrubber solids, located towards the interior of an existing bottom ash dam. The analysis assumed a pond water operating level of elevation 1,004 feet to the outside of the existing bottom ash dam and a pond water operating level of 1,022 feet against the new bottom ash dam, with an assumed pheratic surface passing between the two levels. The analysis considered a

short-term condition with loaded off-road haul trucks operating on the new dam surface during construction and a long-term condition without vehicle traffic. Soil and ash parameters used in the analysis are summarized in Table 7.

Table 7 - Soil and Ash Strength Properties for Pond No. 2 Interior Dams

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
Scrubber Solids	107	35	100
Compacted Bottom Ash	103	35	100
Existing Dam	103	35	100
Liner	Modeled as bedrock		

The results indicated a factor of safety of 1.6 for the long-term condition. Figure 13 shows the output from the analysis.

3.3.4 Pond No. 3

In June 2002 McCain Engineering and Associates, Inc. prepared a report titled *Engineering Report Scrubber Solids Pond No. 3* for NSPC. The report included stability analyses for uplift stability, stability of perimeter embankments, interior slope stability at discharge structures, and potential for sliding of soil and structures along the geomembrane. Soil and waste ash parameters were referenced from the Application for Amendment of NPDES Permit No. 00002186 prepared by Barr Engineering in January 1995. Table 8 summarizes the soil and ash waste properties used in the analyses.

Table 8 - Soil and Ash Strength Properties for Pond No. 3 Perimeter Embankments

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
Granular Fill	120	30	0
Clay	127	30	0
Bottom Ash	103	30	0
Scrubber Solids	107	35	0
Alluvium	120	30	0

The report noted that the inclined clay liner has been designed at all locations in Pond No. 3 so that the factor of safety is 1.3 or greater for uplift stability.

The stability of the North, South and East perimeter embankments was determined for wedge-shaped and circular slip surfaces extending from the crest to the exterior side of the perimeter embankment. Evaluations were completed for potential failure along the clay barrier, through the base of the embankment, and through the foundation. Both static and seismic loading conditions were evaluated. A seismic coefficient of 0.025 was used for seismic loading conditions. Results indicate that the perimeter embankments have a sufficient factor of safety for both static and seismic conditions at the maximum planned elevation. The calculated minimum factor of safety for static condition was calculated to be 1.92, determined for a circular surface extending through the base of the embankment. For seismic conditions, the factor of safety was calculated to be 1.75. Figures 14A and 14B show the stability outputs for the analyses.

The potential for sliding of soil and structures along the geomembrane was evaluated. Several slip surfaces were considered assuming that the geomembrane interface friction angle is 24 degrees. Also the potential for failure beneath structures was evaluated, assuming maximum and minimum water levels in the pond. For the cases analyzed the minimum factor of safety ranged from 1.51 to 1.96 for potential slip along the geomembrane.

3.4 Foundation Conditions

Documents reviewed by CHA indicate that the perimeter dams of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3 were not constructed on wet ash, slag or other unsuitable materials. In Pond No. 1 and Pond No. 2 (and eventually Pond No. 3) the upstream dams constructed for capping and permanently closing the ponds were constructed on sluiced scrubber solids.

3.4.1 Documentation of Foundation Conditions

CHA was provided with Reports No. 1 through No. 24 titled *Inspection and Testing During Earthwork Operations Coal and Ash Storage Areas* dated from July 1975 thorough November 1975. These reports provided documentation of foundation preparation for the Bottom Ash Pond and Pond No. 1.

CHA was also provided with documentation of foundation preparation for Pond No. 3. Documentation included a Construction Documentation and Pre-fill Certification Report for the Scrubber Solids Pond No. 3N prepared by McCain Engineering & Associates, Inc. and dated November 2004.

3.5 Operations & Maintenance

An Operations and Maintenance Plan for Pond No. 2 was prepared and submitted to MN DNR as part of the Application for Amendment of NPDES Permit No. 0002186 prepared by Barr Engineering Company and dated January 1995. The manual pertains to routine operations of the pond and includes information on general facility information, site operating and maintenance procedures, drainage and erosion control system maintenance and inspection, inspection and reporting requirements.

The manual notes in Section 6.2 – Routine Inspections that site inspections for inspecting monitoring equipment, safety and emergency equipment, security devices, survey monuments, drainage systems and sedimentation basins should be conducted on a monthly or semiannual (twice a year) basis. Table 3 lists items which should be inspected monthly (i.e. adequate slope maintenance, adequate liner protection/erosion control, adequate freeboard, adequate surface water drainage, vector/rodent control, dust control, dam integrity, adequate vegetation on cover, adequate erosion control on cover, signs of seepage on perimeter dams, sudden drops in pond level). Table 4 lists items which should be inspected semiannually and after severe rainfall events (i.e., groundwater monitoring points, final cover integrity, surface water drainage system, dewatering system, survey monuments, perimeter dams and haul roads, sedimentation basin build up).

Results of inspections are to be documented in an inspection log maintained at the facility for the duration of its operation. The manual notes that records of operation should be retained for at least five years.

CHA did not receive copies of results of inspections from NSPC for Pond No. 2 or from the other impoundments at the site to review. Based on information gathered during our site visit it is our understanding that NSPC does not have a formal procedure for performing routine dam inspections.

CHA did not receive piezometer data to review for piezometers reportedly installed in Pond No. 1 and Pond No. 2.

3.5.1 State of Minnesota Inspections

Minnesota's dam safety law states that the owner of a dam has responsibility for the maintenance, repair, and liability of their structure. The rules require the owner to keep inspection schedules and also require owner to submit annual performance reports for certain

dams. CHA understands that MNDNR Dam Safety has required NSPC to submit performance reports to the department as part of modification permit requirements during on-going construction projects.

For dams classified as Significant Hazards in the state of Minnesota the frequency of inspections is at least once every four years.

Representatives of the MNDNR Dams Safety Unit inspected the structures at the Sherburne County Power Station on July 16, 2009. A letter was sent to NSPC on August 26, 2009 which stated that *"overall, Dam Safety found the dams to be well maintained and in good condition. No major deficiencies were noted"*. A summary of the inspection findings was included in the letter.

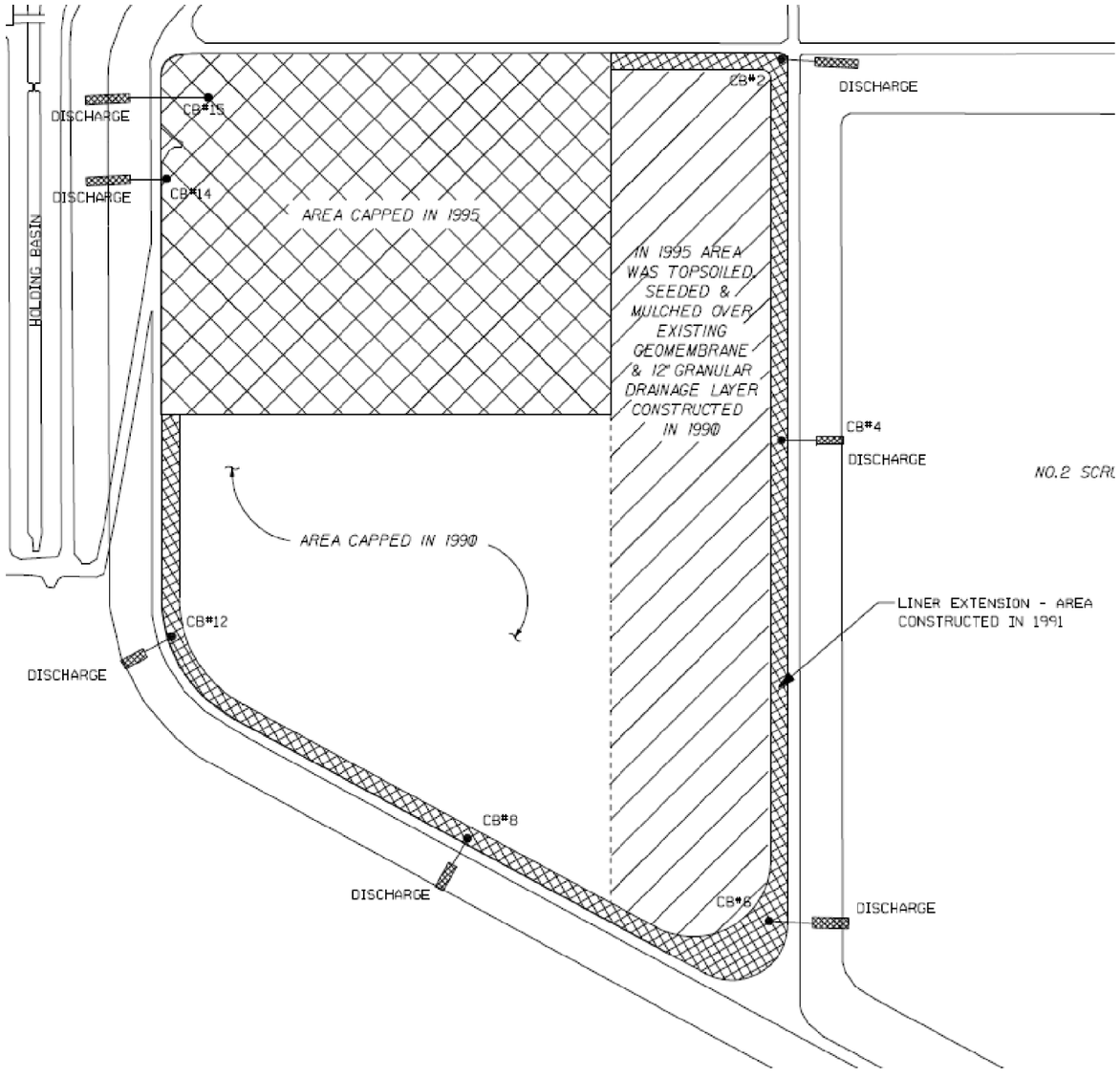


IMAGE REFERENCE: NORTHERN STATES POWER COMPANY, SHERBURNE COUNTY GENERATING PLANT, NO. 1 SCRUBBER SOLIDS POND NORTHWEST CORNER CAP CONSTRUCTION SEQUENCE, DWG. NO. NF-91541-8, 5/12/95

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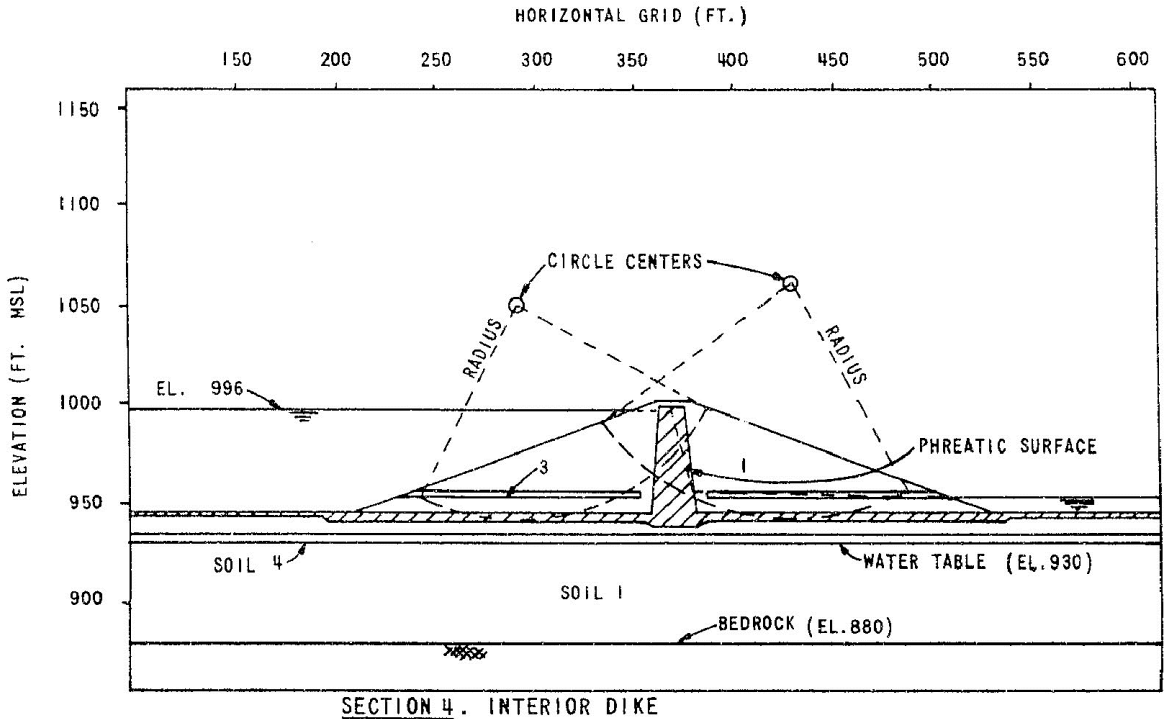
POND NO. 1
CAPPING SEQUENCE
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 9



SECTION 4. INTERIOR DIKE

SCALE: 1" = 80'

SOIL		SOIL PARAMETERS		
NO.	IDENTIFICATION	DENSITY PCF	COHESION PSF	FRICTION ANGLE DEGREES
1	SP-SM EMBANKMENT	136	0	35
2	CL CORE	120	1000	0
3	FILTER	120	0	35
4	SP-SM FOUNDATION (RD 60%)	133	0	30

SLOPE	CONDITION	CRITICAL F.S.
DOWNSTREAM SLOPE (2.5:1)	FULL RESERVOIR (WATER EL. 996 ON U.S.SIDE AND EL. 952 ON D.S.SIDE)	1.65
DOWNSTREAM SLOPE (2.5:1)	FULL RESERVOIR WITH EARTHQUAKE LOADING	1.19
DOWNSTREAM SLOPE (2.75:1)	FULL RESERVOIR	1.79
DOWNSTREAM SLOPE (2.75:1)	FULL RESERVOIR WITH EARTHQUAKE LOADING	1.23
DOWNSTREAM SLOPE (2.75:1)	FULL RESERVOIR (ASH AND WATER ON DOWNSTREAM SIDE AT EL. 970)	1.69
DOWNSTREAM SLOPE (3:1)	FULL RESERVOIR	1.81
DOWNSTREAM SLOPE (3:1)	FULL RESERVOIR (WITH EARTHQUAKE LOADING)	1.30
DOWNSTREAM SLOPE (2.75:1)	FAILURE SURFACE THROUGH CL CORE AND EARTH BLANKET	1.58

FIGURE 10

IMAGE REFERENCE: BLACK & VEATCH, STABILITY ANALYSIS CENTER DIKE

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BOTTOM ASH POND STABILITY ANSYSIS
CENTER DIKE
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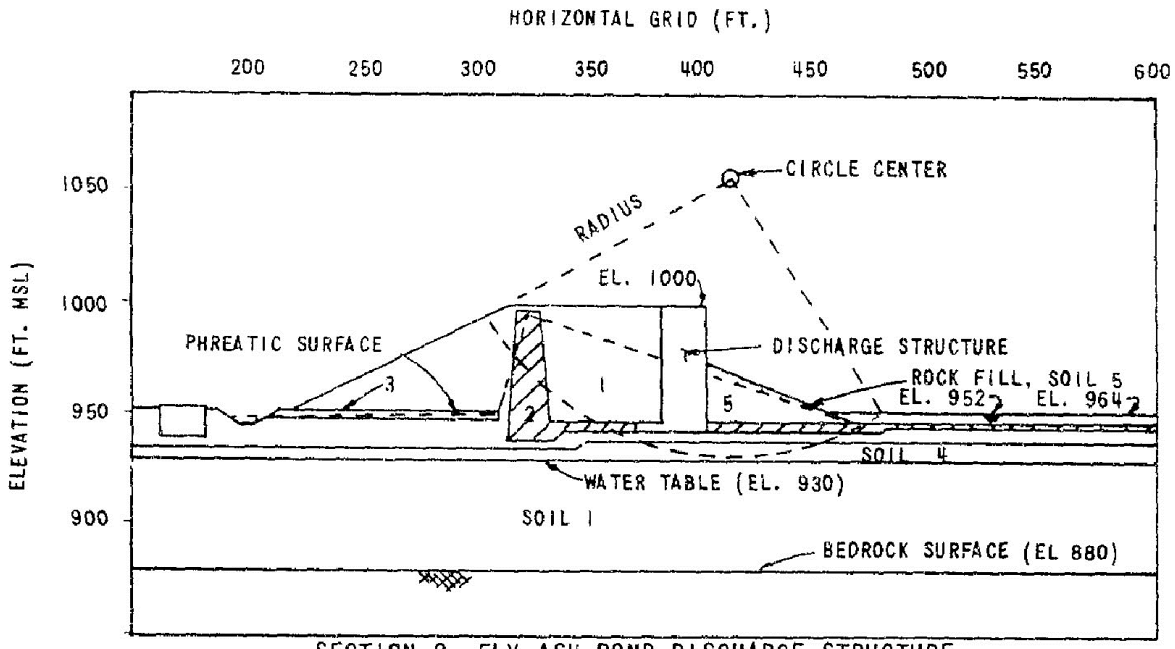
FIGURE 10A



SECTION 2. FLY ASH POND DISCHARGE STRUCTURE

SCALE: 1" = 80'

	SOIL	SOIL PARAMETERS		
NO.	IDENTIFICATION	DENSITY PCF	COHESION PSF	FRICTION ANGLE DEGREES
1	SP-SM EMBANKMENT	136	0	35
2	CL CORE	120	1000	0
3	FILTER	120	0	35
4	SP-SM FOUNDATION (RD 60%)	133	0	30
5	ROCK FILL	120	0	35

TRIAL NO.	COORDINATES OF CRITICAL CIRCLE CENTER		RADIUS OF CRITICAL CIRCLE (FT.)	FACTOR OF SAFETY
	X	Y		
1	393	1035	97	2.13
2	375	1038	95	2.83
3	450	1028	115	1.81
4	420	1058	125	1.48
5	450	1058	144	1.86

IMAGE REFERENCE: BLACK & VEATCH, STABILITY ANALYSIS DISCHARGE STRUCTURE

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BOTTOM ASH POND STABILITY ANALYSIS
DISCHARGE STRUCTURE
SHERBURNE COUNTY POWER STATION
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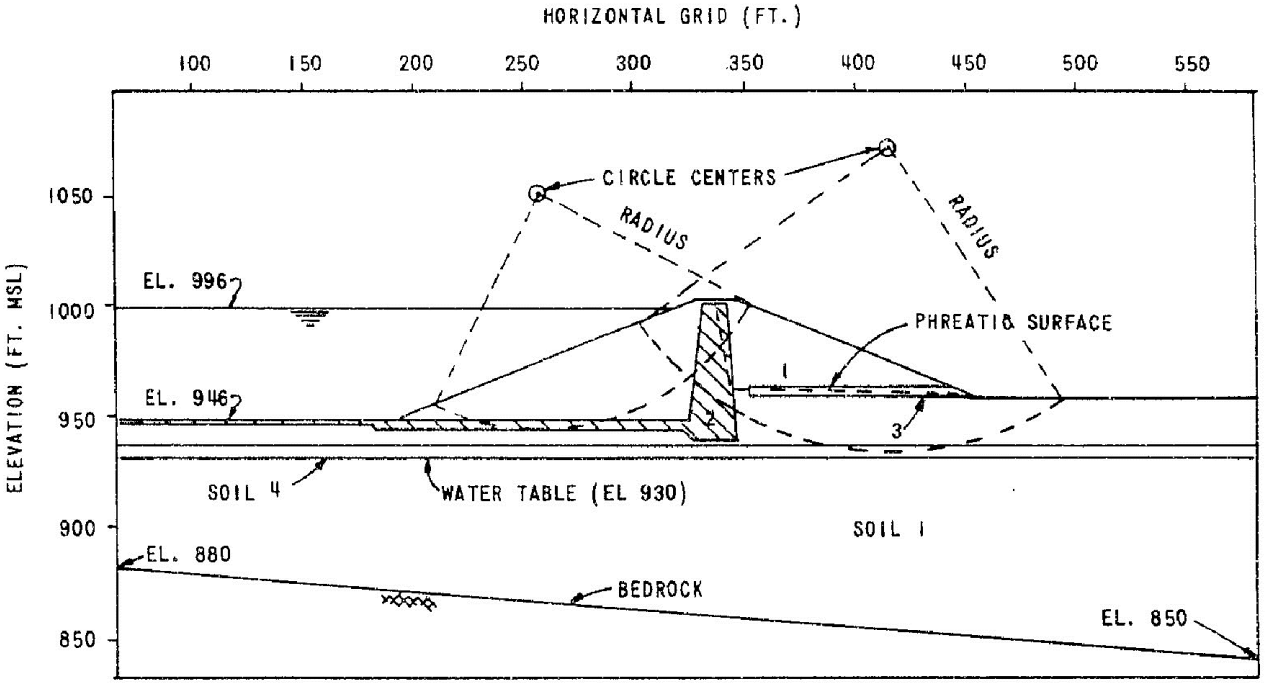
PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 10B



SECTION 5. EAST DAM PHASE II
SCALE: 1" = 80'

	SOIL	SOIL PARAMETERS		
NO.	IDENTIFICATION	DENSITY PCF	COHESION PSF	FRICTION ANGLE DEGREES
1	SP-SM EMBANKMENT	136	0	35
2	CL CORE	120	1000	0
3	FILTER	120	0	35
4	SP-SM FOUNDATION (RD 60%)	133	0	30

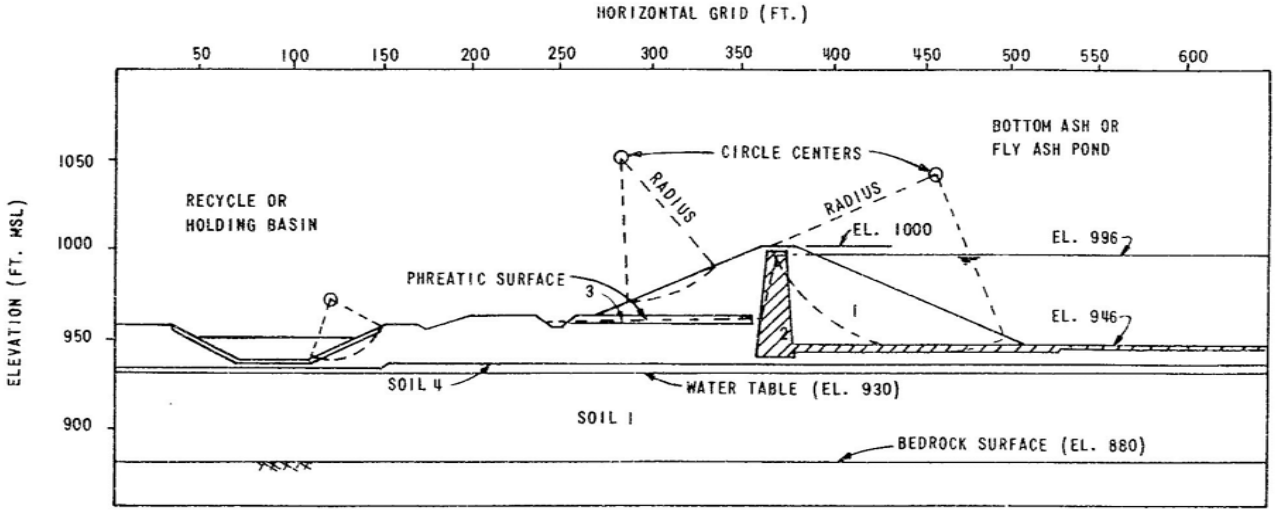
SLOPE	CONDITION	CRITICAL FACTOR OF SAFETY
DOWNSTREAM SLOPE	FULL RESERVOIR (WATER AT EL. 996)	1.79
DOWNSTREAM SLOPE	FULL RESERVOIR WITH EARTHQUAKE LOADING	1.31
UPSTREAM SLOPE	RAPID DRAWDOWN TO EL. 970	1.39

IMAGE REFERENCE: BLACK & VEATCH, STABILITY ANALYSIS EAST DIKE

CHA

BOTTOM ASH POND STABILITY ANALYSIS
EAST DIKE
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 10C



SECTION 1. FLY ASH POND WEST DIKE WITH TOE DRAIN AND HOLDING BASIN BERM

SCALE: 1" = 80'

SLOPE	CONDITION	CRITICAL F.S.
DOWNSTREAM MAIN DIKE	FULL RESERVOIR (WATER AT EL 996)	1.83
DOWNSTREAM MAIN DIKE	FULL RESERVOIR WITH EARTHQUAKE LOADING	1.40
UPSTREAM MAIN DIKE	RAPID DRAWDOWN TO EL.970	1.39
UPSTREAM MAIN DIKE	RESERVOIR FILLED WITH ASH AND WATER UP TO EL.971	1.80
HOLDING & RECYCLING BASIN	AFTER CONSTRUCTION (NO WATER)	1.98
HOLDING & RECYCLING BASIN	DRAWDOWN FROM EL.950 TO 942	1.77

SOIL		SOIL PARAMETERS		
NO	IDENTIFICATION	DENSITY PCF	COHESION PSF	FRICTION ANGLE DEGREES
1	SP-SM EMBANKMENT	136	0	35
2	CL CORE	120	1000	0
3	FILTER	120	0	35
4	SP-SM FOUNDATION (RD 60%)	133	0	30

FIGURE 7

IMAGE REFERENCE: BLACK & VEATCH, STABILITY ANALYSIS WEST DIKE

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BOTTOM ASH POND STABILITY ANALYSIS
WEST DIKE

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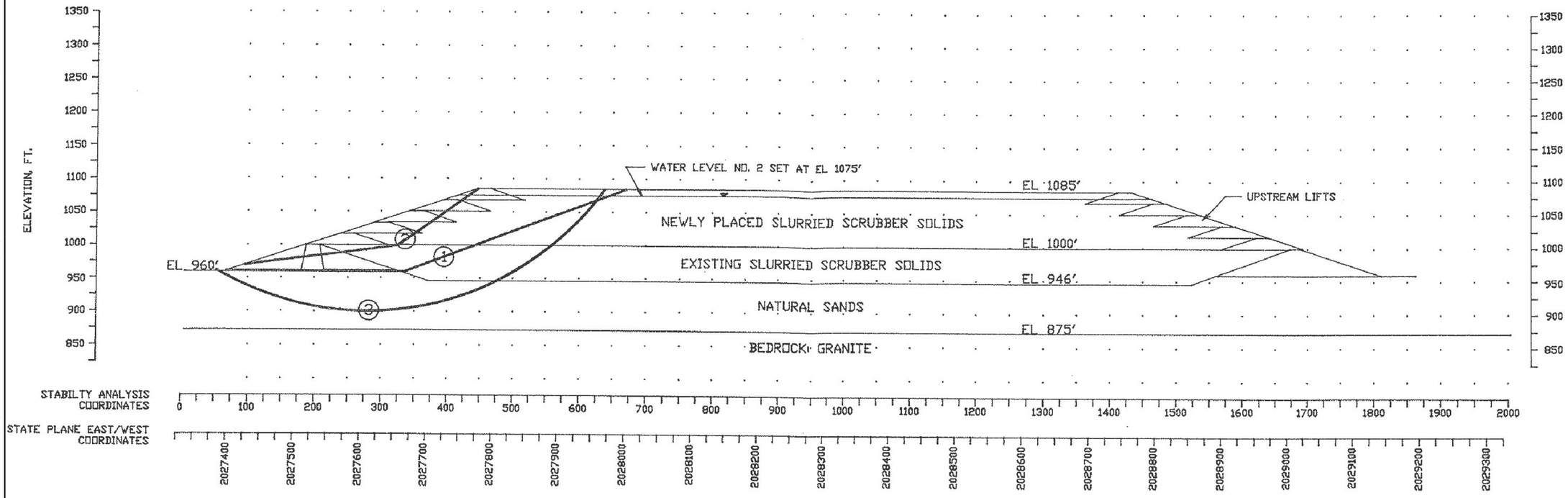
DATE: 10/16/09

FIGURE 10D



RESULTS OF THE STABILITY ANALYSES

SURFACE NO.	DESCRIPTION OF ANALYSIS	METHOD OF ANALYSIS	FACTOR OF SAFETY
1	NONCIRCULAR SEARCH; PIEZOMETRIC LINE NO. 2 DOES NOT IMPACT EXISTING SCRUBBER SOLIDS.	SPENCERS METHOD	1.64
2	NONCIRCULAR SEARCH; PIEZOMETRIC LINE NO. 2 IMPACTS ALL SOIL LAYERS WITHIN NEW AND EXISTING POND.	SPENCERS METHOD	0.91
3	CIRCULAR SINGLE FAILURE SURFACE THROUGH FOUNDATION; PIEZOMETRIC LINE NO. 2 IMPACTS ALL POND LAYERS.	SPENCERS METHOD	3.15

ALL CALCULATIONS WERE PERFORMED USING THE UTEXAS2 COMPUTER PROGRAM DEVELOPED AT THE UNIVERSITY OF TEXAS/AUSTIN.

DESIGN SOIL PARMETERS

SOIL NO.	SOIL DESCRIPTION	TOTAL UNIT WT. PCF	COHESION PSF	FRICTION ANGLE DEGREES	PIEZO LINE NO.
1	NEW SLURRIED SCR. SLD.	80	0	30	2
2	EMBANKMENT SAND	118	150	34	2*
3	SLURRIED SCRUBBER SLD.	80	150	30	2*
4	FOUNDATION SAND-MDENSE	121	0	30	1
5	FOUNDATION SAND-DENSE	135	0	35	1
6	BEDROCK-GRANITE	140	0	45	1
7	CLAY LINER	120	0	23	2
8					
9					
10					
11					
12					

*PORE PRESSURES WERE SET TO ZERO FOR SEVERAL OF THE STABILITY ANALYSES.

VERTICAL EXPANSION LANDFILL
SHERBURNE COUNTY GENERATING STATION
BECKER, MINNESOTA

STABILITY ANALYSES FOR SECTION A-A' AT N865,000 UPSTREAM CONSTRUCTION

IMAGE REFERENCE: NORTHERN STATES POWER COMPANY, SHERBURNE COUNTY GENERATING PLANT, NO. 1 SCRUBBER SOLIDS POND NORTHWEST CORNER CAP CONSTRUCTION SEQUENCE, DWG. NO. NF-91541-8, 5/12/95

CHA
Albany, NY

POND NO. 1 LANDFILL STABILITY ANALYSIS
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010
DATE: 10/16/09
FIGURE 11

Table 2

Soil Properties Used in Geotechnical Analysis

Material	Unit Weight (pcf)	Strength Properties: Friction Angle (degrees)	Strength Properties: Cohesion (psf)	Deformation Properties: Modulus (psf)	Deformation Properties: Poisson's Ratio
Scrubber Solids	107	35	0	600,000	0.35
Compacted Bottom Ash	103	30	0	500,000	0.35
Loose Bottom Ash	81	25	0	100,000	0.35
Weak Waste	107	0	400	10,000	0.35
Scrubber Solids and Dredged Bottom Ash	107	25	0	90,000	0.35
Dike	120	35	0	1,000,000	0.35
Clay Liner	127	30	0	500,000	0.35
Granular Fill	120	35	0	1,000,000	0.35
Alluvium	120	30	0	1,000,000	0.35

P:\SS\2071027\2353d_1\WSD

CHA

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POND NO. 2 STABILITY ANALYSIS BARR ENGINEERING DESIGN PARAMETERS
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 12A

File: K:\20085\CADD\ACAD_SHEET_FILES\2010_12_POND 2 STABILITY ANALYSIS.DWG Saved: 10/16/2009 12:47:01 PM PLotted: 10/16/2009 4:44:01 PM User: Jensen, Andrew

Table 3

Results of Slope Stability Analysis

Conditions	Factor of Safety
Exterior Slope	
a. Circular Failure Through Top of Current Dike	2.16
b. Wedge Failure Through Top of Current Dike	2.46
c. Failure through Foundation	1.74
d. Circular Dike Failure, Seismic Coeff. = 0.025 g	1.94
e. Circular Foundation Failure, Seismic Coeff. = 0.025 g	1.58
Interior Slope	
a. Deep Failure	1.82
b. Shallow Failure	1.55
Discharge Structure	
a. Exterior Slope, foundation failure o Static Loading Conditions o Seismic Coefficient = 0.025	 2.37 2.05
b. Exterior Slope, clay liner failure	2.20
c. Interior Slope - Failure Through PVC-lined Trench o Current Conditions	 1.11
d. Interior Slope - same as (c), including berm o Current Conditions o Dike at Elevation 1000, bottom ash berm o Dike at Elevation 1000, sand berm	 1.51 1.42 1.55

P:\GS\237\237\21610_1\DSD

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POND NO. 2 STABILITY ANALYSIS BARR ENGINEERING RESULTS

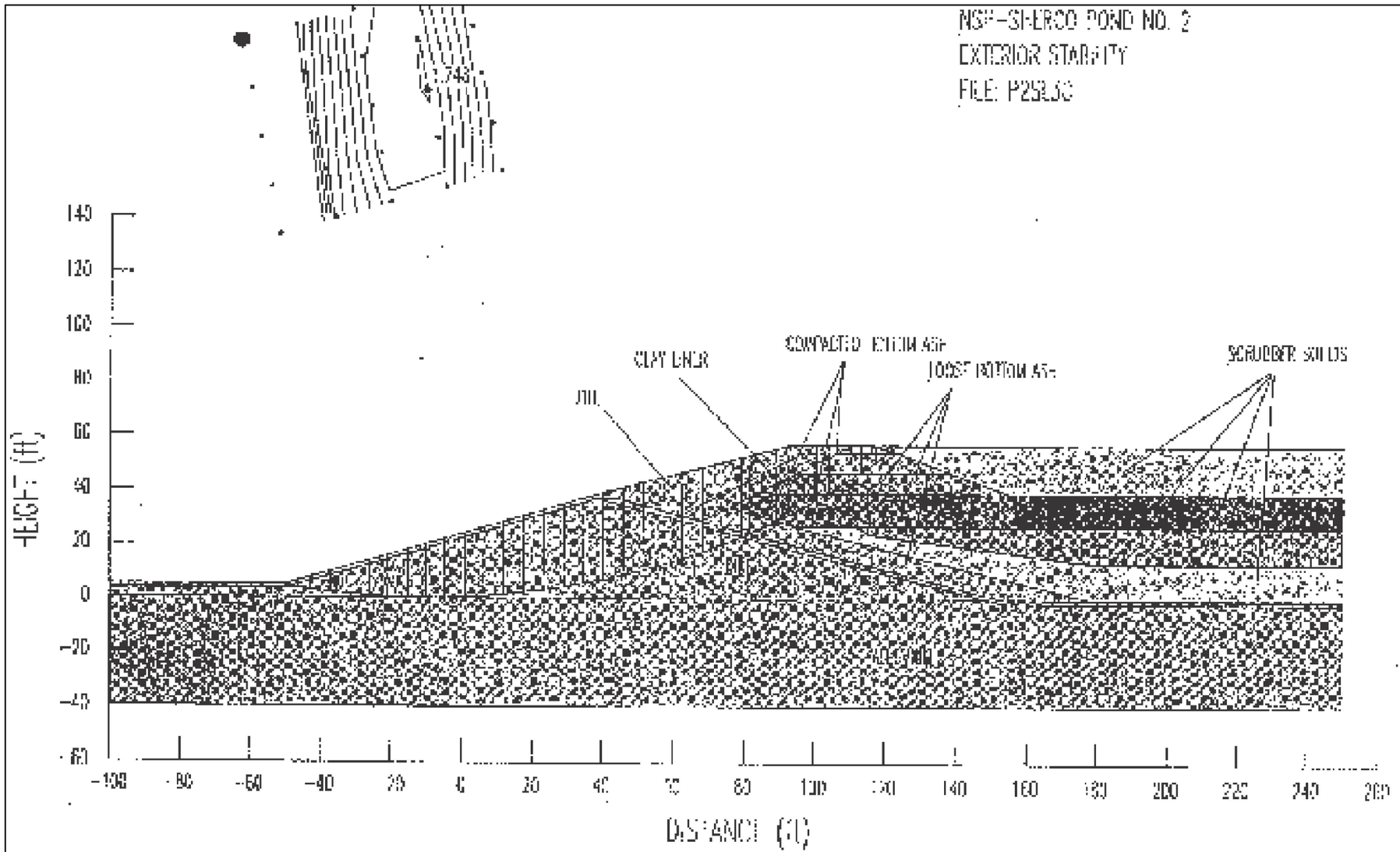
SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 12B

NSP-SHERCO POND NO. 2
EXTERIOR STABILITY
FILE: P2SLOC



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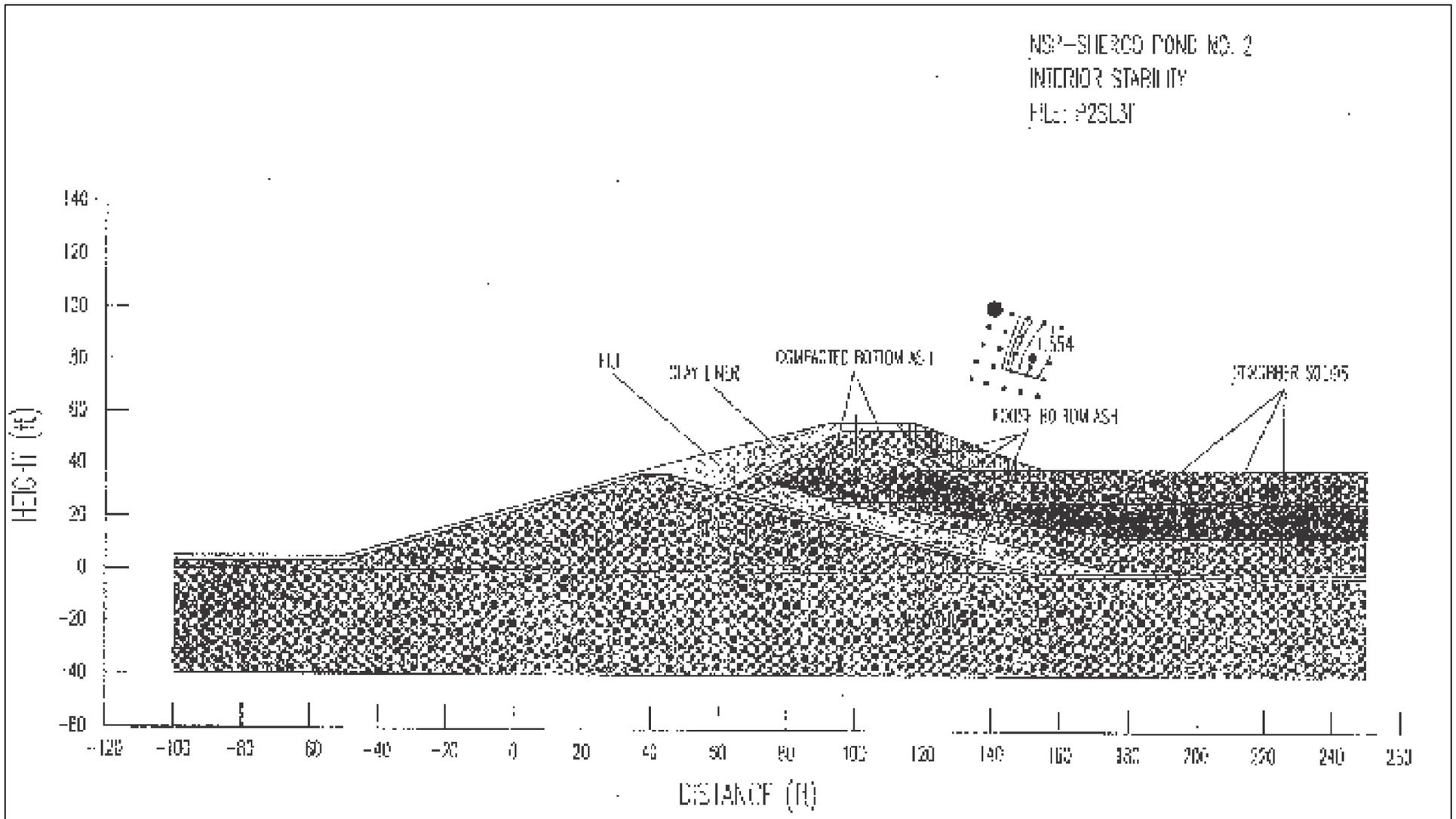
POND NO. 2 STABILITY ANALYSIS

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 12C



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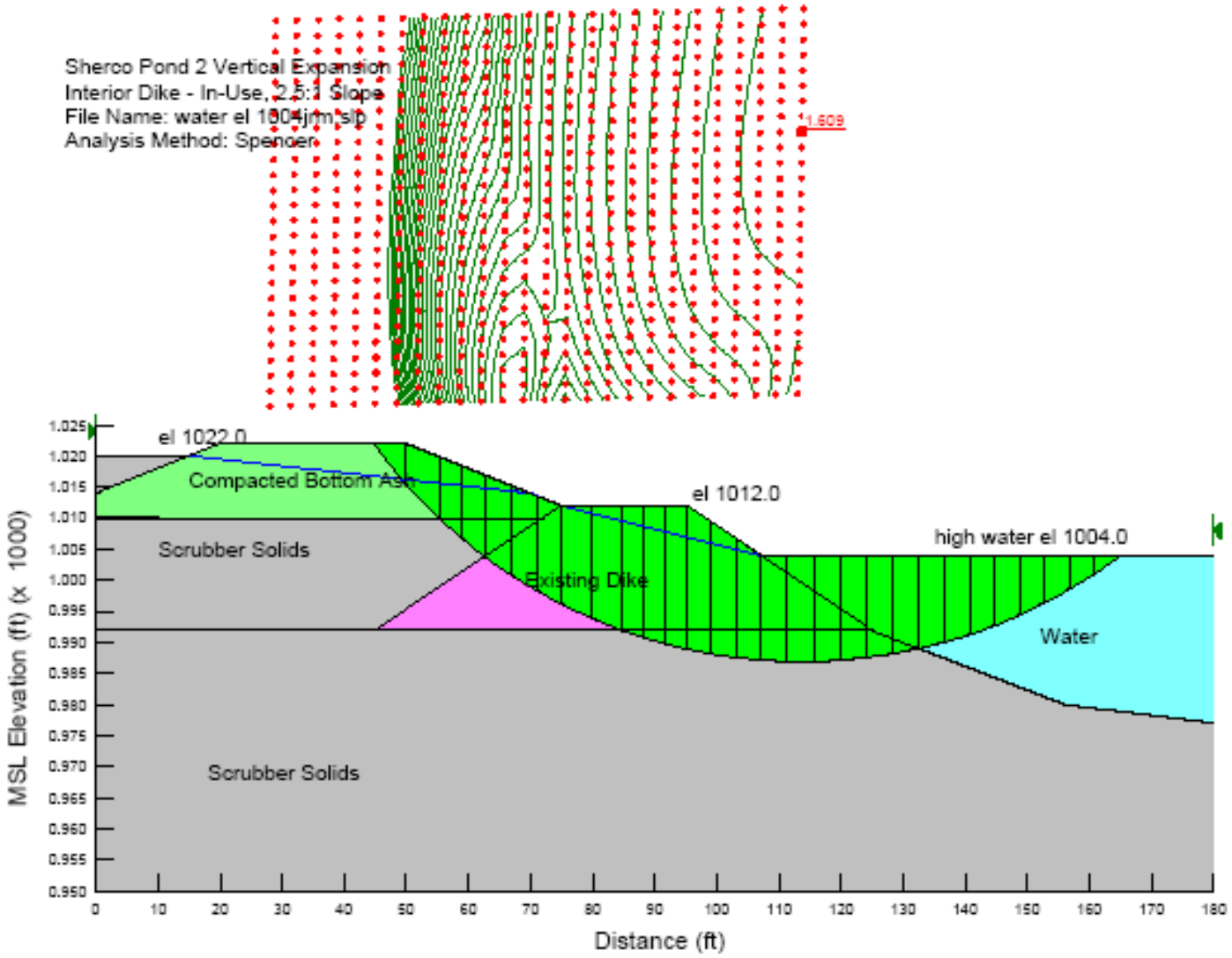
POND NO. 2 STABILITY ANALYSIS SEISMIC

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 12D



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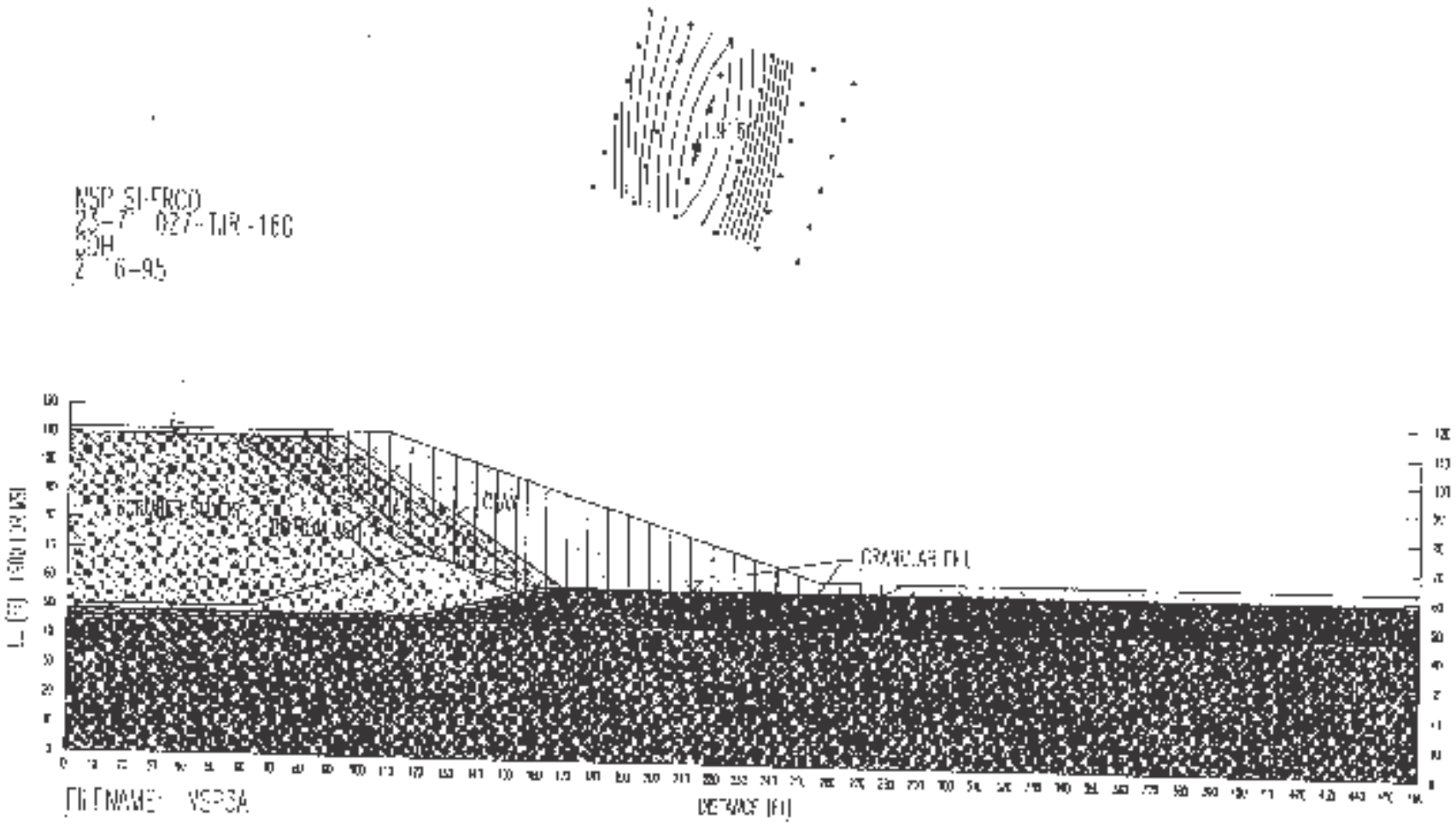
POND NO. 2 MCCAIN STABILITY ANALYSIS RESULTS

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 13



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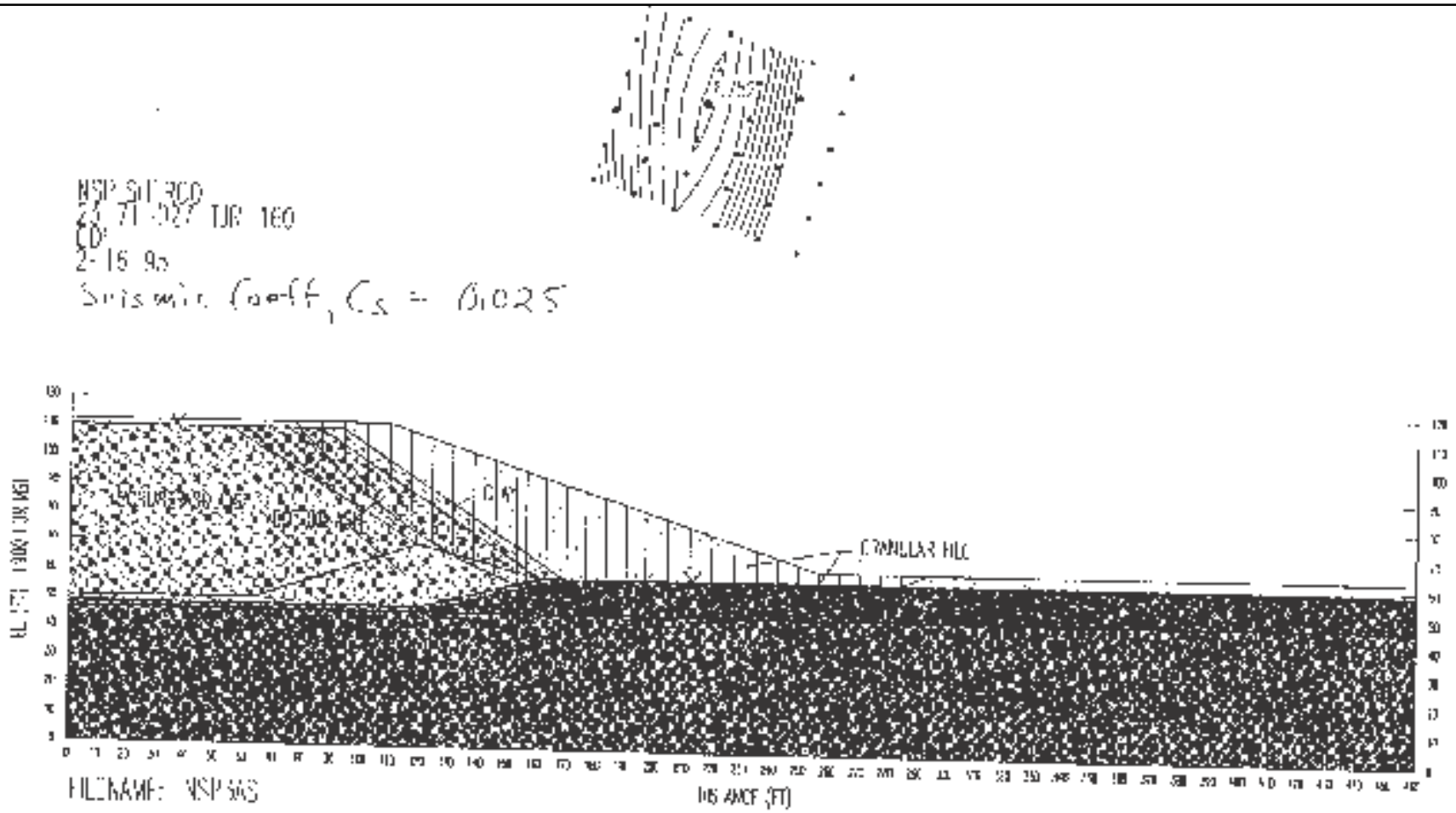
POND NO. 3N STABILITY ANALYSIS RESULTS

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 14A



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POND NO. 3N STABILITY ANALYSIS WITH SEISMIC LOADING RESULTS

SHERBURNE COUNTY POWER STATION
BECKER, MINNESOTA

PROJECT NO. 20085.2010

DATE: 10/16/09

FIGURE 14B

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management units referenced herein was personally inspected by me and were found to be in the following condition: **Satisfactory.**

A management unit found to be in satisfactory condition is defined as one in which no existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions in accordance with the applicable criteria. Minor maintenance items may be required.

CHA's assessment of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3N embankments indicate that they are in satisfactory condition. As described in the following sections, maintenance and monitoring will further enhance the condition of these dams.

4.2 Animal Control and Filling of Existing Animal Burrows

Evidence of animal burrows was observed on the embankment slopes of the Bottom Ash Pond, Pond No. 1, Pond No. 2 and Pond No. 3 dams. A 4.5-foot deep animal burrow was observed on the South Dam embankment approximately two-thirds the distance along the dam that needs to be repaired. At approximately three-quarter distance from southwest corner of the Pond No. 1 West Dam a 6-foot wide gulley, 2-foot deep formed in surface of slope in area of surface undulation that also needs to be repaired. CHA recommends vigilance by Northern States Power Company to make note of areas disturbed by animal activity, trapping of the animals, and repair to the areas to protect the integrity of the dams. In addition, noting the locations that have been repaired will provide a record which can be used to more easily identify active versus inactive animal burrows (i.e. stable versus potentially changing conditions).

4.3 Maintaining Vegetation Growth

Appropriate grass covered most of the dams. However, there were areas of sparse vegetation where reseeding maintenance should be performed. Northern States Power Company should perform reseeding as required yearly to maintain a good grass cover on the dams.

4.4 Erosion Protection and Repair

Erosion rills, sinkholes and subsequent loss of grass cover were observed on embankment slopes. Thinning and loss of grass cover due to concentrated flow from the access roads was noted. On the South Dam of Pond No. 1 a 48-inch wide by 3-foot deep sinkhole was observed that needs to be repaired. CHA recommends filling all rills and sinkholes and reseeding these areas.

4.5 Drainage Swale Maintenance

Vegetation was evident in some of the rip rap drainage swales to the toe of the downstream embankment slopes. Northern States Power Company should monitor the condition of these drainage swales and if the vegetation appears to be clogging the rip rap and impeding surface runoff from being adequately conveyed away from the earthen embankments, the vegetation should be removed from rip rap.

4.6 Tree and Root Removal

Tree roots were observed on the Pond No. 1 South Dam. CHA recommends that Northern States Power Company, under the direction of a professional engineer, remove the root masses in the embankment.

Similarly, trees have established themselves in Pond No. 2 East Dam slope in the area of future Pond No. 3S. CHA recommends these trees be removed under the direction of a professional engineer.

4.7 Monitoring

As discussed in Section 2.4.1, seepage was observed, by MNDNR Dam Safety in July 2009, along the eastern side of the southern pond within Pond No. 2 where water levels appeared to have raised higher that the embankment's clay core. CHA recommends that this area be routinely monitored until area is filled and capped. Monitoring for water levels rising above the embankment's clay core elevation in the active part of Pond No. 2 should become part of Northern States Power Company's routine inspection procedures as further discussed in Section 4.8.

4.8 Inspection Recommendations

CHA recommends that Northern States Power Company implement procedures for routine inspections of the Bottom Ash, Pond No. 1, Pond No. 2 and Pond No. 3. The Operations and Maintenance Plan for Pond No. 2 prepared by Barr Engineering Company and submitted to MN DNR as part of the Application for Amendment of NPDES Permit No. 0002186 in January 1995 is a good document for the facility to refer to for performing these inspections. The manual outlines monthly or semiannual (twice a year) visual observations that should be performed. Table 3 in the manual lists items which should be inspected monthly (i.e. adequate slope maintenance, adequate liner protection/erosion control, adequate freeboard, adequate surface water drainage, vector/rodent control, dust control, dam integrity, adequate vegetation on cover, adequate erosion control on cover, signs of seepage on perimeter dams, sudden drops in pond level) and Table 4 lists items which should be inspected semiannually and after severe rainfall events (i.e., groundwater monitoring points, final cover integrity, surface water drainage system, dewatering system, survey monuments, perimeter dams and haul roads, sedimentation basin

build up). The results of the routine inspections should be documented in an inspection log and maintained at the facility.

5.0 CLOSING

The information presented in this report is based on visual field observations, review of reports by others and this limited knowledge of the history of the Sherburne County Power Station surface impoundments. The recommendations presented are based, in part, on project information available at the time of this report. No other warranty, expressed or implied is made. Should additional information or changes in field conditions occur the conclusions and recommendations provided in this report should be re-evaluated by an experienced engineer.

APPENDIX A

Completed EPA Coal Combustion Dam Inspection Checklist Forms

&

Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sherburne County Steam Plant	Date: September 16, 2009
Unit Name: Bottom Ash Pond	Operator's Name: NSPM d/b/a Xcel Energy Inc.
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: Anthony Stellato, P.E. /Malcolm D. Hargraves	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	no program		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?			19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	d/n/a		Is water entering inlet, but not exiting outlet?	see	note
5. Lowest dam crest elevation (operator records)?	1000		Is water exiting outlet, but not entering inlet?	see	note
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	see	note
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	d/n/a		From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	d/n/a	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?	see	note
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	see	note	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

"d/n/a" = Does not apply "n/a" = Not available

7 Pond was being actively dredged at the time of inspection and the material was being placed in Pond 2 to construct internal dikes as a part of the sluicing and gradual capping process.

16, 20, 21 The inlet and outlet are submerged. Clarified water is recycled through plant for ash sluicing and FGD scrubber sluicing.

18 Isolated surficial deformation/creep noted on downstream north dike slopes near crest and where ash lines entered pond. Rodent activity prevalent on the dike slopes.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MN0002186 INSPECTOR Stellato/Hargraves

Date September 16, 2009

Impoundment Name Bottom Ash Pond

Impoundment Company NSPCM d/b/a Xcel Inc.

EPA Region 5

State Agency (Field Office) Addresss Minnesota Department of Natural Resources
500 Lafayette Road; St. Paul, MN 55155

Name of Impoundment Bottom Ash Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update x

	Yes	No
Is impoundment currently under construction?	_____	x
Is water or ccw currently being pumped into the impoundment?	x	_____

IMPOUNDMENT FUNCTION: Bottom Ash

Nearest Downstream Town : Name Monticello, MN

Distance from the impoundment 3 to 4 miles

Impoundment Location:
Longitude 93 Degrees 53 Minutes 25.7 Seconds
Latitude 45 Degrees 22 Minutes 28.5 Seconds
State MN County Sherburne

Does a state agency regulate this impoundment? YES x NO _____

If So Which State Agency? Minnesota Department of Natural Resources - Waters

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

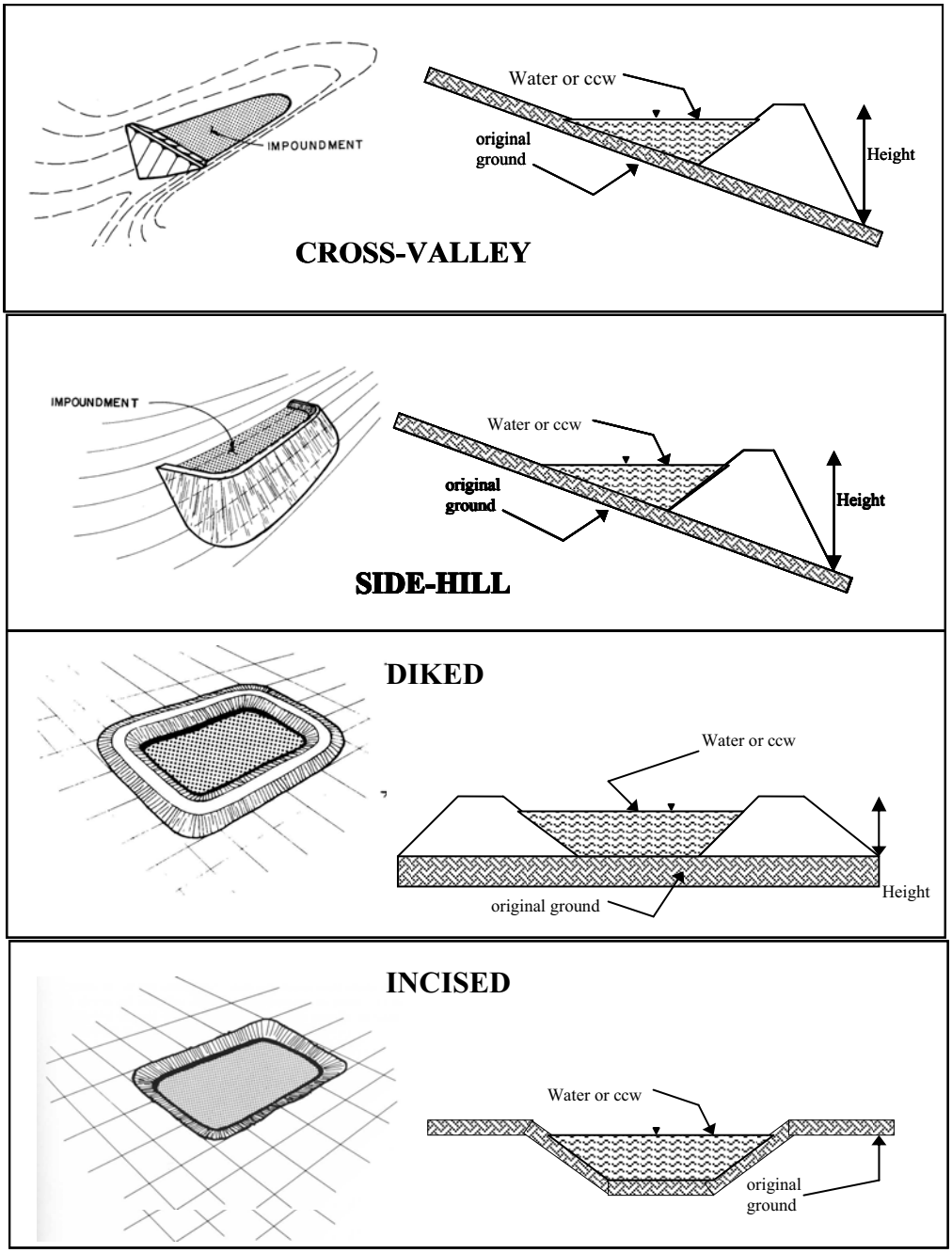
x_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Failure of the west and south dike would probably damage a Sherburne County Electrical Facility cooling tower complex, possibly affect some service roads and driveways beyond the cooling towers, and flood the recycle basin, possibly inducing a discharge to the Mississippi River roughly 1500 to 2000 feet to the south. A breach in the east dike would mainly affect some access drives.

CONFIGURATION:



_____ Cross-Valley
_____ Side-Hill
X_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

Embankment Height 40 feet
Pool Area 18 acres
Current Freeboard _____ feet

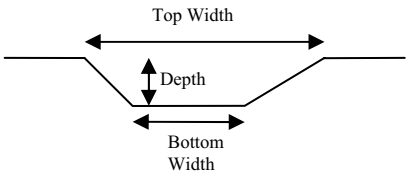
Embankment Material clay core, sand shell
Liner clay
Liner Permeability _____

TYPE OF OUTLET (Mark all that apply)

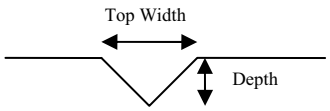
d/n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width
_____

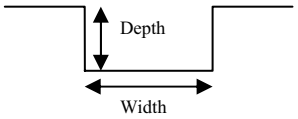
TRAPEZOIDAL



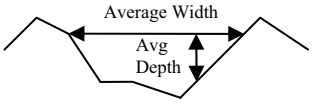
TRIANGULAR



RECTANGULAR

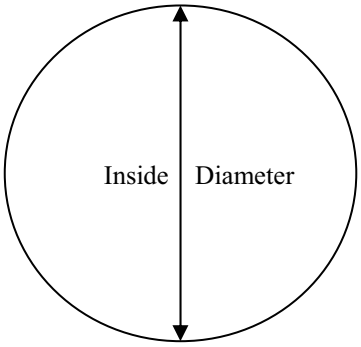


IRREGULAR



x **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
x _____ other (specify) concrete encased clay pipe

_____

Is water flowing through the outlet? YES x _____ NO _____

_____ **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Black and Veatch
_____

Has there ever been a failure at this site? YES _____ NO x_____

If So When? _____

If So Please Describe :

Has there ever been significant seepages at this site? YES _____ NO x_____

If So When? _____

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO x

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sherburne County Steam Plant	Date: September 16, 2009
Unit Name: Pond 1	Operator's Name: NSPM d/b/a Xcel Energy Inc.
Unit I.D.:	Hazard Potential Classification: High Significant Low
Inspector's Name: Anthony Stellato, P.E. /Malcolm D. Hargraves	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	no program		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	d/n/a		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	d/n/a		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	d/n/a		Is water entering inlet, but not exiting outlet?	d/n/a	
5. Lowest dam crest elevation (operator records)?	1000		Is water exiting outlet, but not entering inlet?	d/n/a	
6. If instrumentation is present, are readings recorded (operator records)?	x		Is water exiting outlet flowing clear?	d/n/a	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	d/n/a		From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	d/n/a	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	d/n/a		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?	d/n/a		"Boils" beneath stream or ponded water?	d/n/a	
14. Clogged spillways, groin or diversion ditches?	d/n/a		Around the outside of the decant pipe?	d/n/a	
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	d/n/a		23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

"d/n/a" = Does not apply "n/a" = Not available

1 Xcel does not have an official periodic inspection program.

6 Site has monitoring wells installed through the cap of the closed pond to measure groundwater quality and the effectiveness of the dewatering activities initiated since the pond was closed and capped in 1995. No instruments are in the dike that created the pond in the mid-1970's.

21 Surficial slope deformation/creep due most likely to substantial rodent (pocket gophers, foxes, etc.) activity noted on west dike.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MN0002186 INSPECTOR Stellato/Hargraves

Date September 16, 2009

Impoundment Name Pond 1

Impoundment Company NSPCM d/b/a Xcel Inc.

EPA Region 5

State Agency (Field Office) Addresss Minnesota Department of Natural Resources
500 Lafayette Road; St. Paul, MN 55155

Name of Impoundment Pond 1

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update x

	Yes	No
Is impoundment currently under construction?	_____	x
Is water or ccw currently being pumped into the impoundment?	_____	x

IMPOUNDMENT FUNCTION: Inactive, closed, capped, and substantially dewatered pond

Nearest Downstream Town : Name Monticello, MN

Distance from the impoundment 3 to 4 miles

Impoundment Location:
Longitude 93 Degrees 53 Minutes 24.4 Seconds
Latitude 45 Degrees 22 Minutes 16.0 Seconds
State MN County Sherburne

Does a state agency regulate this impoundment? YES _____ NO x

If So Which State Agency?_____

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

x_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

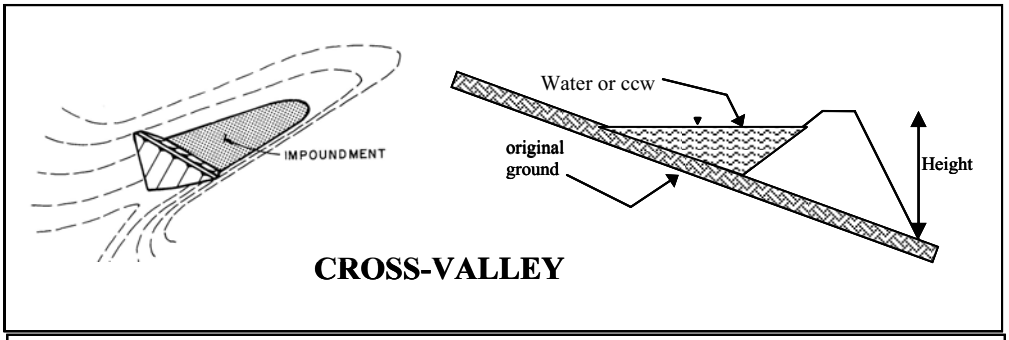
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

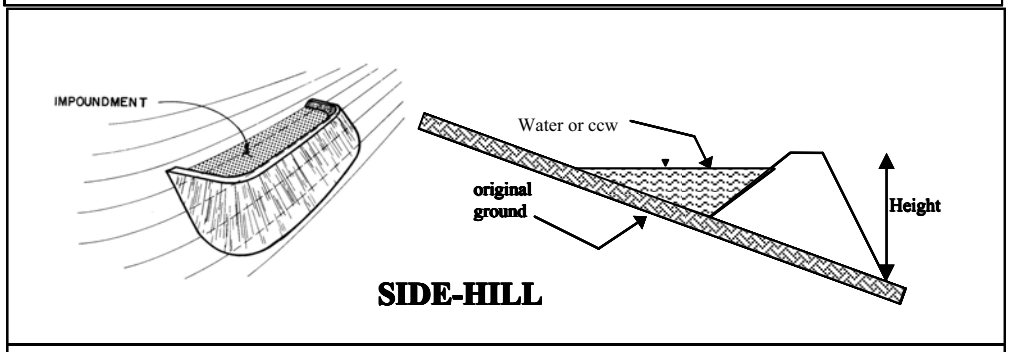
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

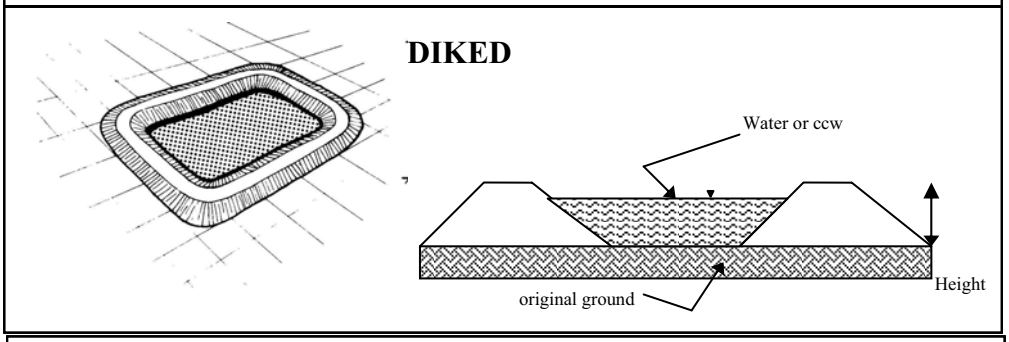
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

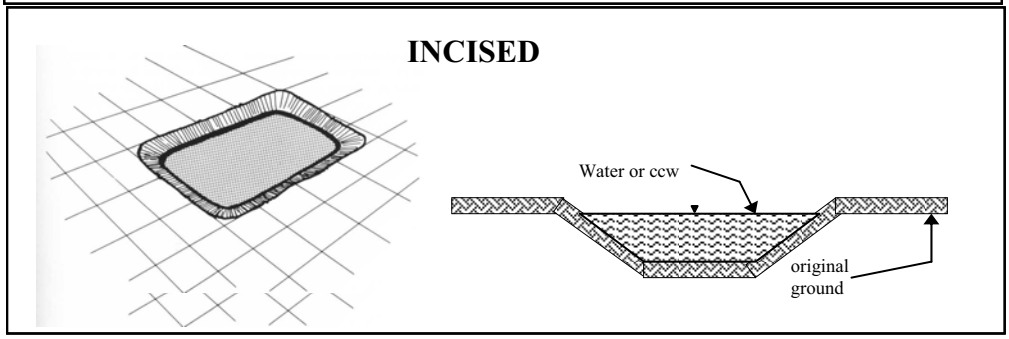
Pond is not active and has been capped since 1995 with a geomembrane and soil cover. Furthermore, to reduce hydraulic head and minimize infiltration through the clay liner and into the sand and gravel groundwater aquifer below the pond, dewatering wells have been installed to remove water from the cell. These wells were installed after the pond was capped in 1995.

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
x_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

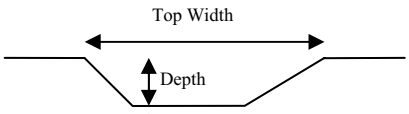
Embankment Height 40 feet
Pool Area 61 acres
Current Freeboard 0 feet

Embankment Material clay core, sand shell
Liner clay
Liner Permeability 10-7 to 10-9 cm/sec

TYPE OF OUTLET (Mark all that apply)

d/n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

TRAPEZOIDAL



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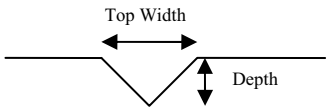
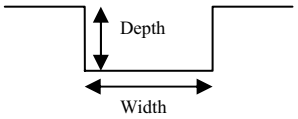
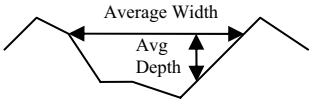


_____ depth
_____ bottom (or average) width
_____ top width
_____

RECTANGULAR

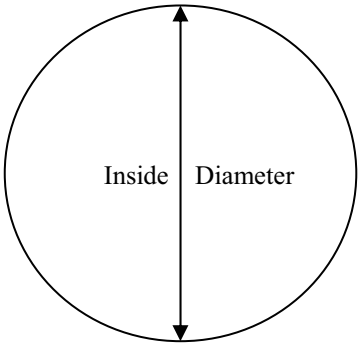


IRREGULAR



_____ **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____

_____

Is water flowing through the outlet? YES d/n/a NO _____

x **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Black and Veatch
_____

Has there ever been a failure at this site? YES _____ NO x_____

If So When? _____

If So Please Describe :

Has there ever been significant seepages at this site? YES _____ NO x_____

If So When? _____

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO x

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sherburne County Steam Plant	Date: September 16, 2009
Unit Name: Pond 2	Operator's Name: NSPM d/b/a Xcel Energy Inc.
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: Anthony Stellato, P.E. /Malcolm D. Hargraves	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	no program		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	1008		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	1008		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	d/n/a		Is water entering inlet, but not exiting outlet?	see	note
5. Lowest dam crest elevation (operator records)?	1012		Is water exiting outlet, but not entering inlet?	see	note
6. If instrumentation is present, are readings recorded (operator records)?	x		Is water exiting outlet flowing clear?	see	note
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	d/n/a		From underdrain?	d/n/a	
9. Trees growing on embankment? (If so, indicate largest diameter below)	x		At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	d/n/a	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?	see	note
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	see	note	23. Water against downstream toe?	x	
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

"d/n/a" = Does not apply "n/a" = Not available

6 Site has vertical and inclined dewatering wells that will be activated when the pond is capped and closed.

9 Isolated trees (2" to 4" in diameter) are on east dike; to be removed as part of Pond 3 S construction in 2010.

16, 20, 21 The decant inlet is submerged and the outlet is submerged below the free water surface in Pond 3 N, precluding direct observation. Some loss of ground/erosion was noted around decant inlet tower.

19 Isolated erosion/ground cover loss at north and east dike downstream slope where erosion protection absent.

23 Downstream toe of east dike is the upstream slope face of Pond 3 which is impounding water.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MN0002186 INSPECTOR Stellato/Hargraves

Date September 16, 2009

Impoundment Name Pond 2

Impoundment Company NSPCM d/b/a Xcel Inc.

EPA Region 5

State Agency (Field Office) Addresss Minnesota Department of Natural Resources
500 Lafayette Road; St. Paul, MN 55155

Name of Impoundment Pond 2

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update x

	Yes	No
Is impoundment currently under construction?	_____	x
Is water or ccw currently being pumped into the impoundment?	x	_____

IMPOUNDMENT FUNCTION: Fly Ash and Wet FGD sludge mixture

Nearest Downstream Town : Name Monticello, MN

Distance from the impoundment 3 to 4 miles

Impoundment Location:
Longitude 93 Degrees 53 Minutes 02.4 Seconds
Latitude 45 Degrees 22 Minutes 10.7 Seconds
State MN County Sherburne

Does a state agency regulate this impoundment? YES x NO _____

If So Which State Agency? Minnesota Department of Natural Resources - Waters

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

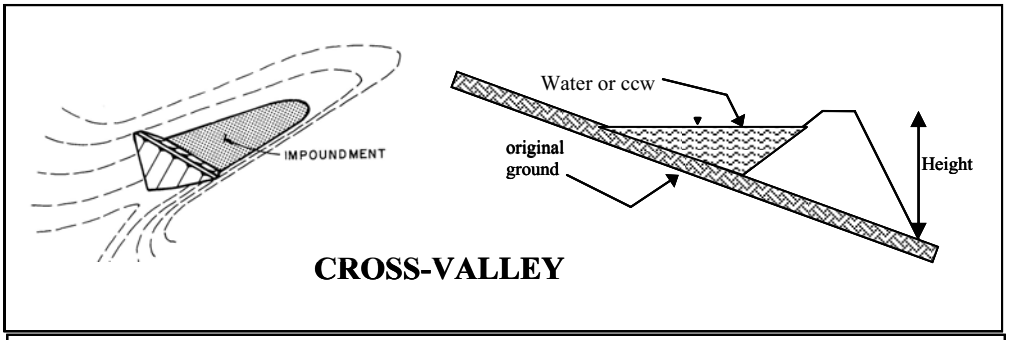
x_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

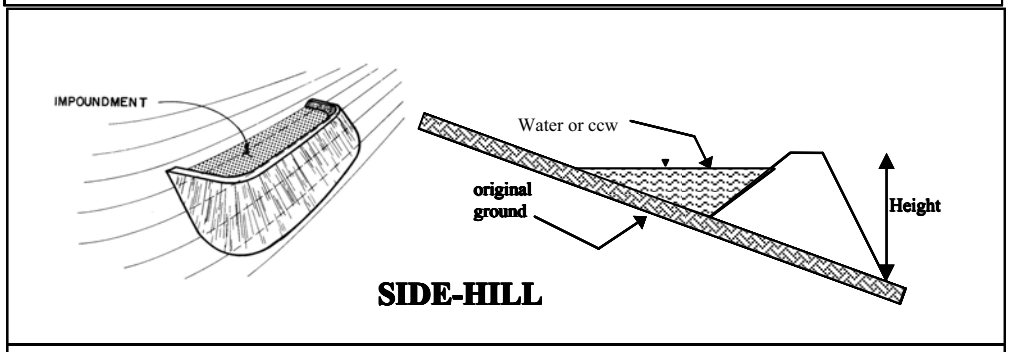
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

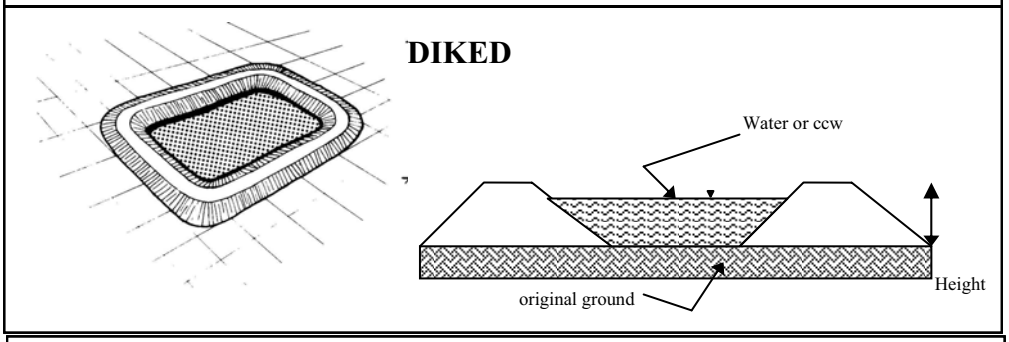
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

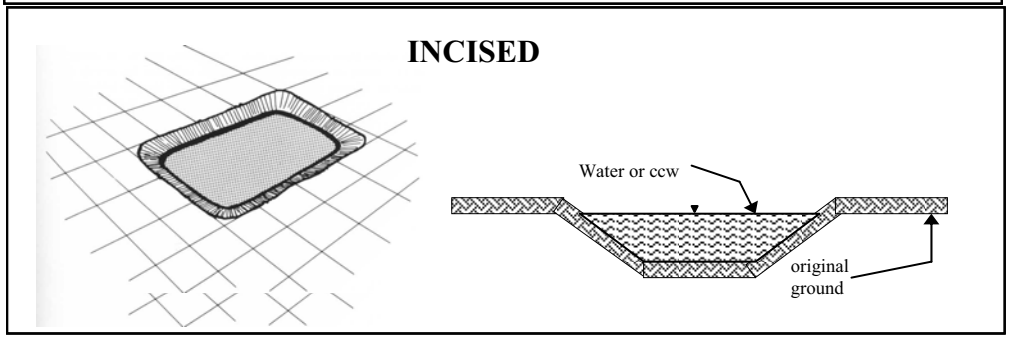
Failure of the south and east dikes would probably affect the Mississippi River approximately 1000 feet to the south, causing negative environmental impacts, and likely impair a landfill operation with its associated service roads to the east. A secondary road, Sherburne Avenue (140th Ave) might also be impacted. A breach in the north dike would adversely affect the Sherburne County Electrical Facility service roads and driveways, and possibly impact a manufacturing facility and access drive (Liberty Lane).

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
x_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

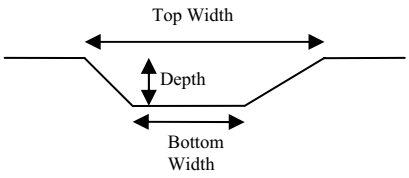
Embankment Height 52 feet
Pool Area 100 acres
Current Freeboard 4 to 5 feet

Embankment Material clay, ash, sand shell
Liner clay
Liner Permeability 6 x 10-8 cm/sec

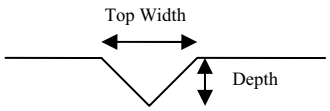
TYPE OF OUTLET (Mark all that apply)

d/n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

TRAPEZOIDAL

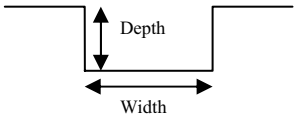


TRIANGULAR

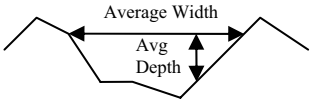


_____ depth
_____ bottom (or average) width
_____ top width

RECTANGULAR

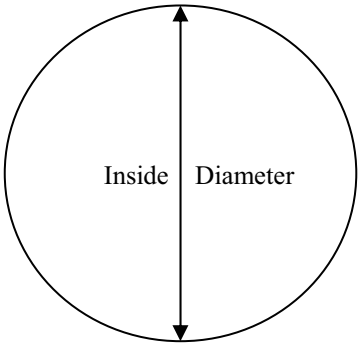


IRREGULAR



x **Outlet**

18" inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
x plastic (hdpe, pvc, etc.)
_____ other (specify) _____

Is water flowing through the outlet? YES x NO _____

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Black and Veatch, Polaris Group, Inc., Barr Engineering Company, McCain and Associates, Inc.

Has there ever been a failure at this site? YES _____ NO x_____

If So When? _____

If So Please Describe :

Has there ever been significant seepages at this site? YES _____ NO x_____

If So When? _____

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO x

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sherburne County Steam Plant	Date: September 16, 2009
Unit Name: Pond 3 N	Operator's Name: NSPM d/b/a Xcel Energy Inc.
Unit I.D.:	Hazard Potential Classification: High **Significant** Low
Inspector's Name: Anthony Stellato, P.E. /Malcolm D. Hargraves	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	no program		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	982		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	982		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	d/n/a		Is water entering inlet, but not exiting outlet?	see	note
5. Lowest dam crest elevation (operator records)?	997		Is water exiting outlet, but not entering inlet?	see	note
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	see	note
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	d/n/a		From underdrain?	d/n/a	
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	d/n/a	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?	see	note
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	see	note	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

"d/n/a" = Does not apply "n/a" = Not available

6 Site has vertical and inclined dewatering wells that will be activated when the pond is capped and closed.

7 Pond dikes to be raised to elevation 1012 from elevation 997 after Pond S is constructed.

16, 20, 21 The inlet and outlet are submerged. Clarified water is recycled through plant for ash sluicing and FGD scrubber sluicing.

19 Very slight erosion and beaching on interior north and east dike upstream slopes where bottom ash and sand / gravel slope surface have not been vegetated. These dikes will eventually be raised to elevation 1012.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MN0002186 INSPECTOR Stellato/Hargraves

Date September 16, 2009

Impoundment Name Pond 3N

Impoundment Company NSPCM d/b/a Xcel Inc.

EPA Region 5

State Agency (Field Office) Addresss Minnesota Department of Natural Resources
500 Lafayette Road; St. Paul, MN 55155

Name of Impoundment Pond 3N
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update x

	Yes	No
Is impoundment currently under construction?	_____	x
Is water or ccw currently being pumped into the impoundment?	x	_____

IMPOUNDMENT FUNCTION: Decanted water, eventually Fly Ash/Wet FGD sludge mixture

Nearest Downstream Town : Name Monticello, MN

Distance from the impoundment 3 to 4 miles

Impoundment Location: Longitude 93 Degrees 52 Minutes 42.2 Seconds
Latitude 45 Degrees 22 Minutes 18.2 Seconds
State MN County Sherburne

Does a state agency regulate this impoundment? YES x NO _____

If So Which State Agency? Minnesota Department of Natural Resources - Waters

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

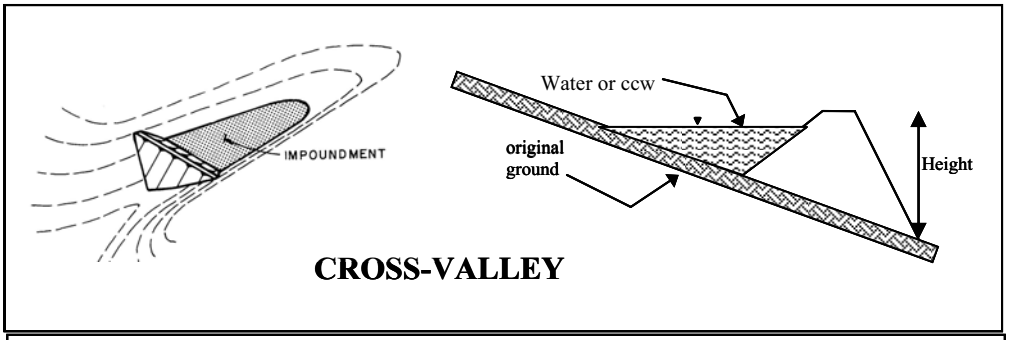
x_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

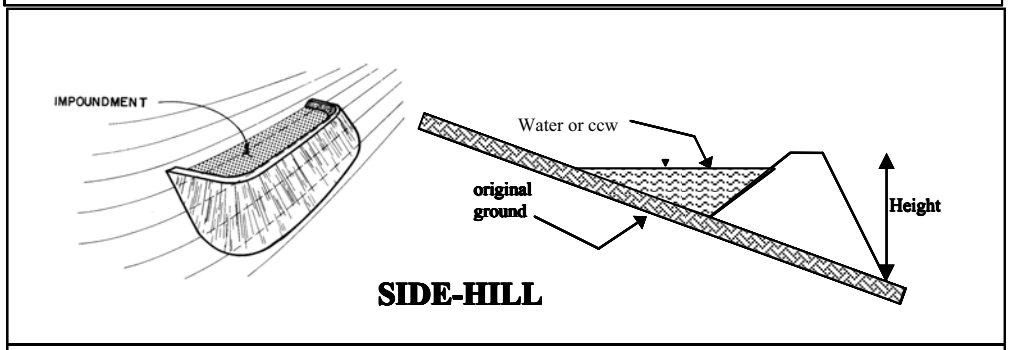
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

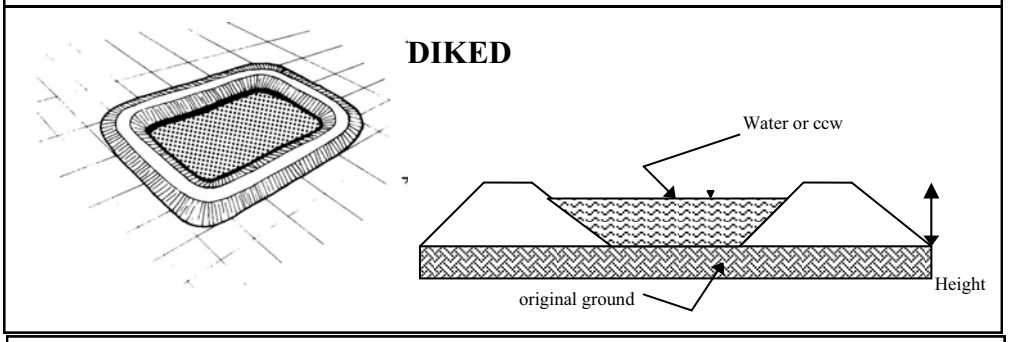
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

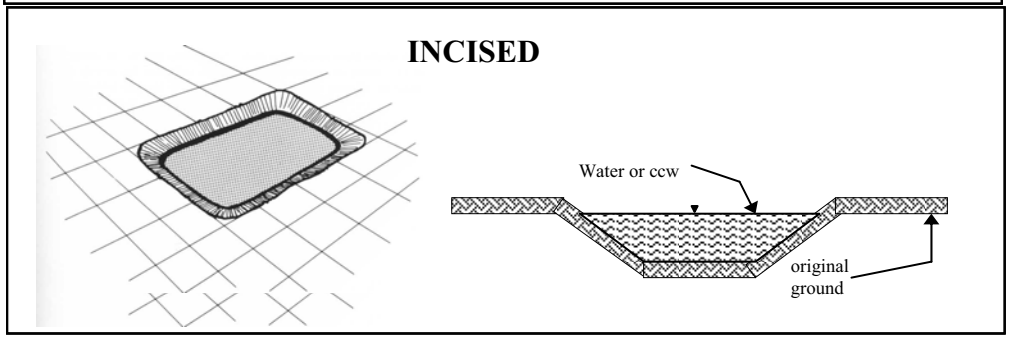
Failure of the south dike would probably affect a landfill operation with its associated service roads roughly 1500 feet to the south of the impoundment and possibly the Mississippi River roughly 3000 to 4000 feet to the south. If the east dike were to fail a secondary road known as Sherburne Avenue (140th Ave) would likely be impacted along with a farm field within roughly 1500 of the pond. A breach in the north dike would adversely affect the Sherburne County Electrical Facility service roads and driveways, and possibly impact a manufacturing facility and associated access drive (Liberty Lane).

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
x_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

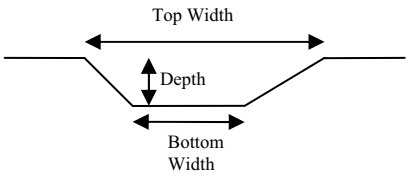
Embankment Height 37 feet
Embankment Material clay, ash, sand shell
Pool Area 50 acres
Liner GCL
Current Freeboard 15 feet
Liner Permeability 5 x 10-9 cm/sec

TYPE OF OUTLET (Mark all that apply)

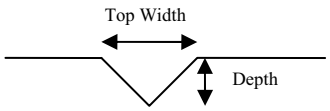
d/n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width
_____

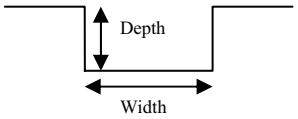
TRAPEZOIDAL



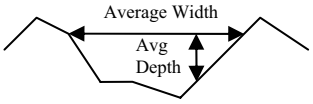
TRIANGULAR



RECTANGULAR

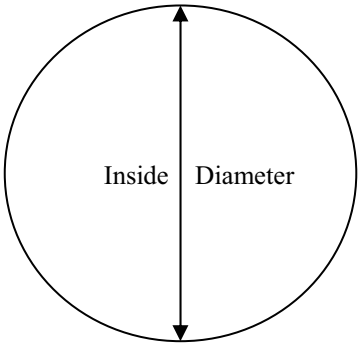


IRREGULAR



x **Outlet**

24" inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
x plastic (hdpe, pvc, etc.)
x other (specify) carbon steel to hdpe

_____

Is water flowing through the outlet? YES x _____ NO _____

_____ **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By McCain and Associates, Inc.
Utility Engineering, Inc.

Has there ever been a failure at this site? YES _____ NO x_____

If So When? _____

If So Please Describe :

Has there ever been significant seepages at this site? YES _____ NO x_____

If So When? _____

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO x

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe :